ELECTRICAL ENGINEERING

With which is Incorporated

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SUMMARY

A complete electric cooking equipment has recently been installed for the new dining-room at Euston Station. The total capacity is 130 kw., and meals are provided for about 400 persons daily (p. 2).

Mr. J. Wilkinson has devised a thermostatic method of electric heater control, in which the current is made and broken between mercury electrodes in an inert gas. He suggests $1\frac{1}{2}$ watts per c. ft. of room space as an average rating for electric heaters (p. 2).

Our Questions and Answers page this week deals with the defection of single cells in a battery, and its causes and remedies (p. 3).

The extremely small number of fatalities due to the use of electricity in mines—especially when compared either with the total number of persons employed and the output of coal—is clearly seen from an analysis of Part II. of the Chief Inspector's report (p. 4).

In a Paper on "Some Electrical Troubles and their Remedies," read before the Association of Mining Electrical Engineers, Mr. T. Anderson dealt with some troubles of a perplexing nature which had occurred to cables and machinery in and about mines (p. 4).

A Paper on "The Ignition of Explosive Gas Mixtures by Electric Sparks," by Mr. J. D. Morgan, reviews the whole question of the possibility of explosives being started from bell circuits. The danger from the spark in the bell itself is easily done away with, but it is pointed out that, without modification, the usual bare wire circuit is dangerous. The author suggests the limitation of the line voltage to 6 instead of 25, and the use of a relay (p. 5).

A patent specification relating to electric furnaces was published during last month (p. 6).

The fifth list of members of the Institution of Electrical Engineers serving with the Forces brings the total number to 1,195 (p. 6).

Among the subjects of specifications published by the Patent Office last Thursday were feeder protection, the production of undamped oscillations by the mercury arc, and a method of obtaining high vacua (p. 7).

We describe, and illustrate, a new catalogue of "Witton" motor starters and controllers (p. 9).

Extensions are to be carried out at the Nechells power station, Birmingham (£100,000); a £40,000 loan has been applied for at Greenock; new plant is required at Hereford and Leek, and electrical stores are required at Croydon and Dublin (p. 10).

A driver in the A.S.C. has died from shock received from falling supply mains in the camp at Blackheath (p. 10).

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

(To-day) Thursday, Jan. 6th: Sections I. and II., shooting.

Fri., Jan. 7th: Sections III. and IV., technical. Sections I. and II., squad. Signalling sections and recruits.

Mon., Jan. 10th: Sections I. and II., technical. Sections III. and IV., squad. Signalling section and recruits.

Tues., Jan. 11th: School of Arms, 6 to 7 p.m.

Thurs., Jan. 13th: Shooting for Sections I. and II., and signalling section.

Fri., Jan. 14th: Sections III. and IV., technical. Sections I. and II., squad. Signalling section and recruits.

Sat., Jan. 15th: Uniform parade.

Appointments: Section-Commander L. A. Levy to be Musketry Sergeant. Section-Corporal J. McArthur Butler to be Section-Commander of No. II. Section.

Sections for technical parade at headquarters, London Electrical Engineers, 46 Regency Street, S.W.

Sections for shooting parade at miniature ranges.

Unless otherwise ordered, all parades at Chester House.

(For "Arrangements for the Week" see p. 10.)

ELECTRIC COOKING AT EUSTON REFRESHMENT ROOMS

THE new dining-room at Euston Station, L. & N.W. Rly., has recently been fitted with a complete electric cooking installation, which we have been afforded an opportunity of examining. Besides being equipped for cooking by electricity, the kitchen, which is in the basement, is, of course, electrically lighted, and the atmosphere of cleanliness and sweetness was very noticeable. The following is a description of some of the chief appliances installed :—

One Range of Four Ovens and Hot Closet on Top.—Overall dimensions, 9 ft. 8 in. by 4 ft. 6 in. by 2 ft. 4 in. deep; internal dimensions each oven, 30 in. by 24 in. by 24 in. deep; of hot closet, 9 ft. 5 in. by 1 ft. 3 in. by 2 ft. deep. The frame is constructed of cast-iron, with bright mouldings, panelled and lined with planished steel, the ovens being well lagged to obtain high thermal efficiency. The fittings are arranged to be easily removable for cleaning purposes. The elements are well protected, and arranged at the sides of the oven to give an even heat distribution. A cast-iron box is arranged to receive the supply cables, which are carried in screwed steel barrel, this arrangement providing a permanent earth connection. The control panel over the hot closet is of cast-iron, all the holes being bushed with insulating material. The switches, fuses, and pilot lamp covers are mounted on the front. The loading of each oven is 5 kw., controlled by means of two 3-heat switches giving 7 degrees of heat. The hot closet has a maximum loading of 3 kw., controlled by means of two single-pole switches.

One Boiling Table.—Overall dimensions, 11 ft. by 4 ft. by 2 ft. 8 in. high. Fitted at one end with bain marie, 4 ft. by 1 ft. 10 in. by 9 in. deep. The top of the boiling table is ground bright, and is a 5/16-in. plate of steel, fitted round the edges with a suitable moulding. Seven 12-in., eight 10-in., eight 8-in. boiling plates are fitted in the top, each being controlled by means of a 3-heat switch, fuse and pilot lamp mounted below the edge of the table and completely enclosed to avoid risk of damage. The connecting wires are carried in watertight cast-iron channels and arranged to be readily accessible. The maximum loadings of the boiling plates are 12-in., 2,000 watts; 10-in., 1,500 watts; 8-in., 1,200 watts. The bain marie is arranged in two sections, each having a maximum loading of 1,500 watts; it is constructed of heavy gauge copper, tinned inside, and provided with removable grid and draw-off cocks. The maximum loading of the boiling table is about 40 kw.

Two Ham Boilers.—Each of 30 gallons capacity, the pan being made of cast-iron, fitted in the bottom with strainers and 2-in. draw-off cock. The boiler is heavily lagged, and cased outside with planished steel. A heavy balanced copper cover is provided, the top rim of the pan being provided with a water lute to prevent escape of steam. The maximum loading of each is 7·5 kw., controlled in three sections by means of single-pole switches, fuses and pilot lamps mounted on a steel switch-box fixed to the wall.

One Grill and Hot Closet.—Overall dimensions, 3 ft. 2 in. wide by 6 ft. 6 in. high, each grilling compartment being 18 in. by 12 in. The grilling elements comprise grooved fire-clay bars, into which spirals of nichrome wire are laid. A grid with a simple raising and lowering device is provided, and the fat is collected in a drawer below the compartment. No elements are fitted in the hot closet, the heat being derived from the grill elements. The control is effected by means of four organ-stop switches mounted below the grill frame. The maximum loading is 7 kw.

One Hot Closet.—6 ft. 3 in. by 2 ft. 6 in. by 2 ft. 9 in. high, fitted with sliding doors and bright top plate, and having a capacity for 1,000 plates. The frame is constructed of cast-iron, with bright mouldings panelled with planished steel, the sides and doors being double-cased to prevent loss of heat. The control is effected by means of two single-pole switches, fuses and pilot lamps mounted below the edge of the top. Maximum loading, 4 kw.

Vegetable Room.—This contains one hot closet, 3 ft. 10 in. by 2 ft. by 2 ft. 9 in. high, constructed and controlled as above, with a maximum loading 2·5 kw., and one steamer, comprising a bottom container, fitted with heating elements, and controlled by means of three single-pole switches, fuses and pilot lamps mounted on a steel switch base fixed to the wall. The maximum loading of the steamer is 4·5 kw.; it is constructed throughout of heavy-gauge copper, nickel-plated. Six steaming compartments are provided, each 19 in. diameter and 6 in. deep, and fitted with steam channels and draining holes.

One Vegetable Server.—5 ft. 9 in. by 2ft. 6 in. by 2 ft. 9 in. high, with a frame of cast-iron with bright mouldings, the top being bright and nickel-plated. Provision is made for receiving two compartments of the steamer, and keeping the vegetables contained therein hot by means of moist heat: this arrangement avoids handling the vegetables, and keeps them hot until required for service. Two nickel-plated soup tureens are also fitted, each being 8 in. by 7 in. by 7 in. deep, and kept hot by means of a water bath. The control is effected by means of six organ-stop switches mounted in the front panels. The maximum loading is 4·2 kw.

One Carving Table and Hot Closet.—Overall dimensions, 11 ft. 8 in. by 3 ft. 1 in. by 2 ft. 9 in. high. The top is a bright rolled steel plate, fitted with a suitable moulding round the edge. The frame is of cast-iron, panelled with planished steel, the sides and doors being double-cased to prevent loss of heat. Sliding doors are fitted on both sides, and on the side opposite the carver a heated shelf 14 in. wide runs the full length of the table. Five cutting dishes, 19 in. by 14 in., of No. 16 gauge "Silverling" metal are fitted in the top, and provision is made for using half the table only if required. Covers provided with the usual overhead balanced gear are fitted. The control is effected by means of six single-pole switches, fuses and pilot lamps mounted below the edge of the top. The maximum loading of the table is 8 kw. and of the shelf 2 kw.

One Double Grill.—Overall dimensions, 5 ft. 2 in. wide by 6 ft. 7 in. high by 1 ft. 10 in. deep, each grilling compartment being 24 in. by 12 in. The internal dimensions of top hot cupboard are 4 ft. 2 in. by 1 ft. 3 in. by 1 ft. 1 in., and of the bottom one 4 ft. 2 in. by 1 ft. 3 in. by 1 ft. 6 in. The frame is constructed of cast-iron, with all the mouldings and facings bright and nickel-plated, the doors being panelled in white porcelain enamel. The grilling grids are fitted with a simple raising and lowering device, and trays are provided to drain the fat into the drawers below the grilling compartments. The control is effected by means of organ-stop switches and pilot lamps mounted in the pillasters at each side. The maximum loading of each grilling compartment is 5 kw. and of the bottom cupboard 2·5 kw., making a total loading of 12·5 kw.

The total maximum power taken by the complete installation is about 130 kw. Each separate appliance is fitted with its own electric meter, so that its performance can be accurately observed. So far, the results are said to have been very satisfactory. The total number of meals provided per day is about 400. The equipment was installed by the Brompton & Kensington Accessories Co., Ltd., under the supervision of the L. & N.W. Rly. Company's chief electrical engineer, Lieut.-Col. Cortez Leigh, T.D.R.E., to the requirements of the Hotel Department.

THE WILKINSON METHOD OF ELECTRIC HEATER CONTROL

IN a Paper read before the Scottish Section of the Institution of Electrical Engineers, on December 14th, Mr. George Wilkinson, of Harrogate, advocated a rating for electric heaters of not less than 1½ watts per c. ft. of room space, increasing to 2 watts for rooms which are draughty, have an exposed aspect, or an abnormal window area. He favoured the use of thermostatic control, so that the heater may be automatically switched on as soon as the temperature of the room drops below a comfortable value, and switched off again as soon as this is exceeded. Rooms heated with coal fires, he pointed out, are subject to fairly wide variations in temperature, and he suggested that this might be levelled by the use of thermostatically-controlled electric heaters to make up the deficiency in those cases in which electric heating was not adopted entirely.

The greater part of the Paper was devoted to describing a thermostatic control which he had devised, with a view to having something less bulky and expensive than the Grundy system (see ELECTRICAL ENGINEERING of December 31st, 1914, p. 662), and also to dispense with the low-voltage battery which the Grundy system requires.

Mr. Wilkinson's thermostat, he claimed, is capable of breaking 30 watts at 250 volts, which is five or six times its normal duty. The thermostat, which was described and illustrated in considerable detail in the Paper, breaks the circuit between platinum and mercury electrodes in an atmosphere consisting of an inert gas. The thermostat operates a circuit-breaker for the radiator itself, in which the break also takes place in an inert gas; in this case the electrodes are concentric pools of mercury; one of these is made to rise by the expansion of the gas, which is heated by a coil controlled by the thermostat. Contact is established and made and broken quickly by the surface tension of the mercury. He has controlled 30 amperes at 200 volts successfully by this means, but the standard rating of the circuit-breaker is fixed at 15 amperes. An alternative arrangement worked electrically, instead of by the heating coil and expansion of the gas, was also described in the Paper.

Other applications of the thermostatic control, Mr. Wilkinson suggested, are fan control and the thermostatic regulation of gas stoves.

New Year's Honours.—The long list of New Year's Honours does not contain a great deal of electrical interest. The only two honours of interest to our readers are the Knighthood conferred upon Mr. George Franklin, Chairman and Managing Director of the late National Telephone Company, and the C.B. granted to Mr. Garnham Roper, Assistant Secretary to the Board of Trade, who is in charge of matters relating to the Electric Lighting Acts.

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,476.

In an A.C.–D.C. motor generator, which was disconnected from the supply and reconnected again, the connections were accidentally changed, so that the machine ran in the wrong direction. No current could be obtained from the D.C. side. Why was this?

(*Replies must be received not later than first post, Thursday, Jan. 13th.*)

ANSWERS TO No. 1,474.

Describe in detail the best practical methods used to-day for boosting up the voltage of defective individual cells in a battery. What is the cause of, and remedy for, this defection of single cells?

The first award (10s.) is given to "P. H. S." for the following reply:—

Method of Boosting.—The periodical overcharge which the whole battery receives will usually restore a low cell to normal if the reason for its falling off has been found and removed. If this is not satisfactory, an overcharge must be given to the low cells independently of the main battery. This can be done as follows:—(1) If the cells have their elements bolted together, cut out the defective cell or cells during several discharge periods, and cut them in again during the following charge periods. (2) If the elements are burnt together, or if any other reason, such as loss in voltage of the main battery, prevents the cells being cut out altogether during the discharge periods, an individual charge can be given to the defective cells while the battery is standing idle. This can be done from the main generator through a water resistance or from a small milking booster, if one is available.

Cause of Defection of Single Cells.—There are several reasons for the defection of a particular cell. The chief are as follow:

(1) Sediment may collect and put the plates in contact. The result is continued undercharging due to some of the charging current passing through the contact thus formed. A defective separator may also allow two plates to come into contact and produce the same result. (2) Low insulation resistance from earth or the other cells will cause excessive discharging, and the consequent sulphating prevents sufficient charging. (3) Low level of electrolyte will throw too much work on the submerged portion of the plates and lead to excessive charging and discharging. (4) Impurities in the water or acid will attack the plates, throw down precipitate, and thus lower the specific gravity of the electrolyte. (5) The electrolyte may be contaminated by foreign substances falling into it. This has the same effect as No. 4.

Remedy.—This depends upon the extent and cause of the trouble. Usually, if the battery is carefully examined and all short circuits and sediment removed, followed by an overcharge as described above, the trouble will be cleared. The sediment is usually higher under the centre plates, so that for some time it can be levelled down with an L-shaped tool of insulating material and thus save the trouble of emptying the cells.

If the defect has been caused by impure electrolyte the battery must be emptied and thoroughly cleaned and fresh electrolyte added. In this case the battery should be fully charged and the elements carefully lifted out. The tanks should then be thoroughly cleaned, the elements replaced, and fresh electrolyte added. The elements must not be allowed to become dry. In the case of very large cells a good method is to syphon off the electrolyte, flush the cells with a jet of water strong enough to stir up the sediment, at the same time syphoning off the water with the sediment in suspension. Fresh electrolyte should be added when all the sediment and water has been removed.

The second award (5s.) is given to "M. M." for the following:—

For ordinary-sized plants the usual method is to cut faulty cell out on discharge and join up again from the charge. Objection to this is that the "burnt" joint at accumulator lugs has to be broken. This, however, is not such a drawback as it may appear, because only one lug has to be disconnected and it is not a great difficulty to solder or even burn the joint again. Another way is to run the charging dynamo with its field excited by a few cells only, thus giving just sufficient voltage at the brushes to charge the faulty cell. The regulating switch for end cells gives a means for obtaining the exciting current in steps of two volts, further regulation being obtained with the adjustable resistance in the shunt winding. Thus the faulty cell can be charged without breaking any connection.

The best arrangement is to have a small motor-generator set to charge up defective cells. These sets are capable of giving full charging current at a low voltage; if mounted on a truck they can be readily moved to the cell requiring special treatment.

No one can either state the cause or suggest a remedy with absolute certainty. It can, however, be asserted with confidence that several nostrums, credited by some people with certain virtues, are useless, constant care and attention are the best possible antidotes against cell troubles.

As suggested causes, the following may be noted:—Paste falls out and short-circuits the plates. Dirt and deposit accumulate at bottom of cell and short the plates. Remedy for this is obvious. Sometimes plates will buckle and touch; this may be prevented by frequently going over the cells and passing a slip of wood between the plates.

Never charge higher than 2·5 volts nor discharge lower than 1·8 volts. When charging to reduce sulphate, do not overcharge, or paste may be thrown out by the escaping gases.

Always keep cells well "topped" with distilled water, and never let them remain out of use longer than is possible.

A New Nernst Lamp.—A paragraph in the Berlin paper *Elektricität* for December 12th states that Prof. Nernst, of Nernst lamp fame, has patented a new vapour lamp, in which the vapour from metals is employed instead of mercury vapour. Zinc chloride and zinc bromide have been employed, and give the best results at atmospheric pressure. As in the mercury arc, the inclusion of air or other foreign gases in the tube is prejudicial. On the other hand, an arc in an atmosphere of aluminium chloride or titanium chloride is more stable, and an admixture of nitrogen is harmless. Oxygen, however, must not be added. It is stated that the colour of the light is white, and that the efficiency is in the neighbourhood of that of the mercury vapour lamp.

British Trade with India.—The review of trade with India for the year to March 31st, 1915, by the Director of Statistics to the Indian Government, calls attention to the extent to which German electrical machinery, electrical equipments for collieries, and electrical wiring accessories have found a market in British India hitherto. The Calcutta market has, in late years, been flooded with cheap German materials for electric wiring, such as cables, switches, ceiling roses, and cut-outs, but in heavier machinery this effect has not been quite so pronounced. British merchants are urged to do their utmost to keep the trade in their own hands in future.

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

ELECTRICITY DECREASES THE DEATH-ROLL IN MINES

A CAREFUL analysis of "Part II.: Labour," of the Annual General Report of the Chief Inspector of Mines for 1914, which has just been issued, throws an interesting light on the result of the extension of the use of electricity in mines. It shows that the miners' contention that electricity is an added danger is not merely an exaggeration, but is an actual travesty of the true facts.

The number of deaths in mines from all causes per 1,000 persons employed has been continuously decreasing; owing to the use of electricity, the output expressed in tons per person employed has been enormously increased, and the number of deaths due to electricity itself has been insignificant.

Out of the total of 929,807 persons working underground in mines during 1914, 1,086 were killed by accidents, and, of these, 4 only were killed by electricity. This represents only one electrical accident underground for every seventy million tons of coal raised.

In fact, no more danger attends the use of electricity underground than above ground, where, again, there is no greater risk than in the use of electricity in other industries. The statistics actually tend to show that there is less danger underground, or perhaps we should say they prove that, owing to the greater care and the proper precautions being taken, the number of fatal accidents are far fewer in proportion. In 1914, as has been said, there were 4 fatal electrical accidents below ground for a total of 929,807 persons employed there; above ground about the mines 227,648 persons were employed, and there were 5 fatal electrical accidents.

In the section of the Report dealing with Electricity in Mines, a return, made in accordance with the requirements of the Coal Mines Act, of the aggregate horse-power of electric motors in use about mines, gave the following approximate figures, which are in thousands of h.p.:—Scotland Division, 137; Northern, 170; York and North Midland, 124; Lancashire, North Wales, and Ireland, 36; South Wales, 194; Midland and Southern, 53. These figures show an aggregate increase of 13·64 per cent. over the corresponding figures for 1913. The number of electrically-driven coal-cutting machines in use at the end of 1914 was 1,415, an increase of 108 over the number in use at the end of 1913.

The figures for electrical accidents below ground for the years 1907 to 1914 inclusive were 10, 12, 13, 15, 9, 7, 13, 4. The extremely low figure for 1914 is very satisfactory, considering the 13 per cent. increase in the horse-power of electric plant mentioned above. The report of the circumstances of the nine fatal accidents mentioned shows that in three cases the persons were doing unauthorised work or exceeding instructions, and one other was the result of practical joking. In the latter case the pressure was only 220 volts, but the accident occurred during very wet weather, so that the deceased happened to make a good earth connection. Besides fatal accidents, there were also 41 non-fatal electric-shock accidents reported, as against 51 in 1913. In the case of an accident at Clifton Colliery, near Workington, Cumberland, the evidence tended to show that gas was ignited at an electric starting switch; it was supposed to be oil-immersed, but it was afterwards found that a screw plug in the bottom of the oil vessel was loose enough to allow of the escape of oil, with the result that the live contacts were exposed and caused open sparking when the switch was operated.

The energy of the inspectors with regard to the enforcement of regulations is shown by the fact that there were 23 prosecutions of owners, agents, or managers for contraventions of safety provisions. Of these cases, 16 were dismissed, withdrawn, or "not proven," there were only five convictions, and in the remaining two cases the offenders were merely admonished. As the total amount of the fines inflicted and costs imposed was only £20 14s., it must be concluded that the infringements of the regulations were not very serious.

In fact, the report may be taken to be one of the best certificates of the value of electricity in mines and the efficient and safe manner in which it is applied. The more the use of electricity is extended, the greater will be the output and the safer will be the miner's occupation.

SOME ELECTRICAL TROUBLES AND THEIR REMEDIES

IN a Paper on this subject recently read before the West of Scotland Branch of the Association of Mining Electrical Engineers, Mr. T. Anderson gave an interesting account of some troubles he had met with on electrical apparatus in mine service. He described some half dozen particular cases, which are briefly as follows:—

A 200-yard length of three-core, paper-insulated, lead-covered, 3,000-volt cable, which ran overhead from a power-house to a transmission pole, was continued by bare conductors to a sub-station at a mine about a mile away. While the installation was on full load, the circuit-breaker in the power-house opened, and as everything appeared to be all right at the sub-station end, and the breaker repeatedly opened on switching on the power, it was concluded that the fault was in the cable. This was tested with a 1,000-volt megger, and showed a short-circuit between two phases. The trifurcating boxes at both ends of the cable were opened, and the bitumen cleared out, but the joints showed no fault. The cable was then connected to a 500-volt generator, whose field was allowed to build up slowly, but the full 500 volts produced no effect, the cable being apparently all right. The megger, however, again showed a short-circuit. After many attempts to find the fault, whose resistance was subsequently found to have increased to ½ megohm, it was decided to try and burn it out with H.T. current. The cable was connected to the high-tension side of a transformer with a heavy copper fuse in circuit, and the switch closed. A hole was blown through both lead and iron armour of the cable about 10 ft. from one end. It was assumed that moisture had got in at the end and crept along the paper insulation, thus causing the trouble.

The second case was that of a small squirrel-cage induction motor driving a water-pump, which was found to be running considerably below normal speed. An examination of the motor windings was made for bad or wrong connections, or shorted coils, the voltage of supply was tested, an ammeter was put in to see if the motor was overloaded, but everything appeared to be normal. The motor was then disconnected from the pump, and reached its normal speed quite readily. It was found, however, that the shaft could easily be held by hand. An examination of the rotor showed a light film of oil and dirt between the bars and end-rings, and it was evident that this film set up a high resistance in the rotor circuit and caused the reduction of speed on load.

The next case dealt with referred to two similar 150-kw. two-phase alternators, which, when run in parallel, carried a large circulating current which did not reach the external circuit. The windings and connections of the two alternators were traced out, and found to be quite in order, and precisely alike. Tests were made for slipping of belts, but no slipping was found. Phase voltages of both machines registered the same. Adjustments of the exciting currents made no difference to the circulating current, and all efforts to solve the trouble failed for a time. Finally, it was determined to try and find out whether there was any difference in the voltage waves of the two machines, and as no oscillograph was available, a lamp was connected across one phase of each machine, which was then rotated slowly. It was observed that in one case the lamp light fluctuated in synchronism with the revolutions, instead of maintaining a steady value. This indicated a lack of uniformity of magnetic flux around the machine, and examination showed that the air-gap at the top of the rotor was double that at the bottom. On raising the bearings to equalise the gap the trouble disappeared.

The next two cases dealt with by the author were troubles due to centrifugal force. In the first, a 500-kw. revolving field generator failed to excite when running, and it was found that a metal sleeve containing a joint between the end of a field coil and a lead contained no solder whatever, and centrifugal force caused one of the wires to recede from the other, thus opening the circuit. In the second case, some rotor strap connections were separated by centrifugal force, owing

to rivets in them having worked loose, the solder melting due to the heat produced at the imperfect joint.

In concluding the Paper the author described a method of locating faults in a mining locomotive armature, with an earthed return, which has been found simple and reliable, no other instrument than an ordinary ammeter being required. The armature is taken apart from its field circuit (so that it cannot revolve where current is sent through it) and fixed on a cradle arrangement with the brushes in position. The controller, fields, and armature are then all wired up exactly as they would be when working with an ammeter in circuit, and about full-load current is sent round the circuit. The armature is then turned slowly round by hand. Should there be any open-circuited coils, there will be a flash at the point of open-circuit, and short-circuited coils will very soon become hot. Since one side of the system is permanently earthed, should there be any earth on any of the controller or armature winding, there will again be flashing.

IGNITION OF EXPLOSIVE GAS MIXTURES BY ELECTRIC SPARKS

AN interesting Paper on this subject was read last month by J. D Morgan at the Birmingham Section of the Institution of Electrical Engineers. A discussion of the general theory was first entered upon, and it was shown that the ignition of gases does not depend merely on heat, but that it is of ionic origin. Where a hot wire or spark is the source, ignition only occurs when ionisation is produced, and ionisation alone without heat has been found to be capable of causing ignition. On the other hand, certain diminutive electric sparks will not ignite a highly inflammable gas, although their temperature may be well above the ignition temperature. Glowing cordite emitting a spray of sparks cannot ignite a coal-gas jet, in spite of the obviously high temperature of the sparks.

A number of curves by Dr. Wheeler and some by Professor Thornton were given to show that gas mixtures are only combustible when the proportions lie within certain limits. The particular curves given showed, for instance, that mixtures of methane and air containing less than 5·6 per cent., or more than 14·8 per cent., of methane are incapable of ignition, and they showed further the least current required to produce a single igniting spark with variations in the mixture between these limits. Mr. Morgan pointed out, however, that the repeated sparkings which were found by these experimenters to be incapable of igniting the gas were produced at a comparatively slow rate, and he himself had found that a single spark which when repeated slowly will not ignite a gas will, after a more or less definite interval, produce ignition when repeated rapidly. The element of time seemed to him to be a factor of importance in ignition phenomena. If instead of a single-break device, a vibratory make-and-break device (such as the trembler of a bell) were employed, it would be found that the ability of a given spark to ignite a gas mixture depends upon the duration of the sparking.

A curve was given by the author showing a typical result following the use of a trembler spark in an explosive atmosphere consisting of a 10 per cent. mixture of coal-gas and air. The current was approximately 0·4 ampere throughout the range of the experiment. At 9 volts, ignition was obtained instantly. On reducing the voltage to 7, a single break-spark would not ignite the gas, even when repeated as rapidly as hand-manipulation would permit; but when the trembler was allowed to vibrate normally, ignition due to the trembler spark occurred after 1 second. At 5 volts ignition occurred after 10 seconds. This fact appears to be of practical importance in connection with that system of bell signalling commonly used in mines, in which the circuit is closed by the application of a piece of iron to a pair of bare wires. Sometimes an old file or a knife is used, and whatever be the implement employed the surface is usually rough. In drawing this implement across the wires there is not obtained the single spark of carefully maintained laboratory apparatus, but a rapid succession of sparks approximating to that of the trembler.

The general conclusion to which the author was led by a variety of experiments on the electrical ignition of gases was that it is necessary to distinguish between the energy which produces a spark and that quality of the spark termed by him "incendivity," which enables the spark to cause ignition, and that the magnitude of the one is not a measure of the other, although there may be a more or less regular relation between them when certain physical conditions are

kept constant. Ignition seems to depend on the ionisation caused by the spark. During the interval of sparking the ionisation may be rapidly dissipated or neutralised. If the neutralising action predominates there is no ignition of a gas mixture. If there is little or no neutralising action, ignition occurs immediately. Between these two limits there are a variety of intermediate conditions, which apparently account for delay of ignition and much of the great irregularity that is often experienced in experimental work on this subject.

The author went on to say that the outstanding fact of practical importance is that circuits carrying relatively small amounts of electrical energy are capable of producing dangerous sparks. No fact is more familiar, and at this date no justification could be found for addressing to electrical engineers a Paper on the subject of gas ignition by sparks were it not for the existence in many mines of a crude but indispensable piece of apparatus—the electric bell signalling circuit—which in consequence of at least one serious disaster has excited the suspicion and attention of those responsible for the safety of mines, and caused a revival of inquiry into the facts associated with spark-ignition.

The prevention of ignition by sparks in the power and lighting circuits of mines has been thoroughly investigated, and, excepting accidental breakage of cables, no danger need be apprehended if the usual protective devices are maintained in proper condition. The open sparking on the bare wires of the bell systems has, however, been neglected, and an urgent necessity has arisen to render it harmless. Although the bare-wire system has much to commend it on the score of simplicity and convenience, it has latterly become the subject of much suspicion, especially since the Senghenydd disaster in 1913. Mr. Morgan considered that the danger associated with bare signal wires had been much exaggerated; nevertheless, he said, some danger does exist, and it is well that the risk should be eliminated.

Danger of gas ignition at the trembler of a bell has been minimised by the use of an enclosing case, but experiments show that when using a bell of the ordinary type the break-spark which occurs on the bare circuit when a signal is given can be not less dangerous than the trembler spark. An arrangement, illustrated below, was described by the author, which has been found to give good results at both the trembler and the break. The action at the trembler is the reverse of the ordinary action. Instead of interrupting the circuit, the trembler short-circuits the magnet. The magnet windings are indicated by *a*, and the spring-controlled arma-

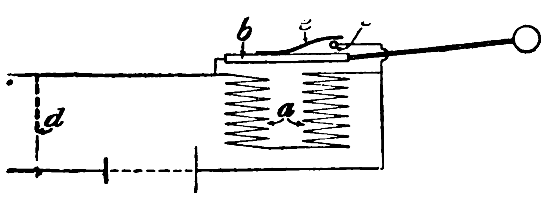


FIG. 1.

ture by *b*. One end of the armature is connected to one end of the magnet coils, and the fixed contact *c* is connected to the other end. When the external circuit is closed as indicated diagrammatically at *d*, the magnet is excited and the armature is attracted. Near the end of the movement a spring blade *e* on the armature touches the fixed contact *c* and short-circuits the magnet. By means of its spring the armature is returned, and the parts *c* and *e* are separated. The action is then repeated and a vibratory motion of the armature is obtained. Only a very minute spark is produced at the trembler, and this is entirely negligible. The intensity of the single break-spark at *d* is not reduced, however, to the same extent, and although it is much less active than when the ordinary trembler construction is used in the bell, it is possible to produce ignition of an explosive coal-gas mixture.

Notwithstanding such improvements as these, the author said that the complete solution lay in a suitable relay system. By using a small relay arranged to be actuated by a 4-volt battery he obtained perfect operation of the bell with a current of 0·1 ampere in the relay circuit. Sparking in the external circuit of the relay was quite insignificant, and no ignition of coal-gas could be obtained. It was necessary to increase the relay current to 0·6 ampere before ignition could be produced.

In conclusion, the author expressed the opinion that the Home Office Regulations limiting the highest permissible voltage in bell signalling systems to 25 cannot secure safety. The figure should be reduced to 6. With the adoption of a relay system this lower figure was practicable. There should be added the condition that sparks produced in the system should not be capable of igniting a specified mixture of methane and air.

Electrometallurgical Patents.—The only patent specification published at the Patent Office during December which deals with the applications of electricity in the mining and metal industries is No. 1,173 of 1915, in which F. BASSANESE describes certain improvements in the construction of a form of oscillating or tilting arc furnace for melting and refining metal in which the tilting of the electrodes can be effected separately or simultaneously. The electrodes enter the melting chamber through conical apertures, and are gripped by rollers sliding as pistons in air-cooled cylinders adapted to oscillate over the aperture outside the chamber.

ELECTRICAL MEN ON ACTIVE SERVICE

THE fifth list of members of the Institution of Electrical Engineers on military service has been issued, and includes 162 names, bringing the total to 1,195. The first list was published in our issue of Jan. 21st, the second on Feb. 18th, the third on March 4th, and the fourth on July 15th. We give the fifth list in full below:—

MEMBERS.

G. L. Andrews (Lieut. R.G.A.); H. Bell (Capt. 1/3rd Northumbrian Field Co., R.E.); G. A. Bruce (Major R.M.); C. G. Cadman (Malay States Volunteer Rifles); J. Caldwell (2nd Lieut. 3/6th Argyll and Sutherland Highlanders); C. B. Chartres (2nd Lieut. Calcutta Port Defence Volunteers); R. H. Covernton (Lieut. South African Engineer Corps); B. J. Day (Capt. Glamorgan Yeomanry); R. J. M. Holmes (2nd Lieut. Northumbrian Divisional R.E.); Prof. C. F. Jenkin (Lieut. R.N.V.R.); G. Marconi (Lieut. Italian Army Engineers); S. Paterson (2nd Lieut. Royal Engineers); F. C. Raphael (A.B. Anti-Aircraft Corps); H. M. Sayers (A.B. Anti-Aircraft Corps); J. C. Shields (2nd Calcutta Cyclist Volunteers); W. T. Taylor (Capt. 1/23rd Loyal North Lancashire Regt.); H. Lyon Thomson (Capt. Army Service Corps); H. L. Tyson-Wolff (East Indian Railway Volunteer Rifles); R. P. Wilson (Sub-Lieut. Anti-Aircraft Corps); H. E. Wimperis (Lieut. R.N.V.R.).

ASSOCIATE MEMBERS.

F. C. Aldous (Capt. 6th Manchester Regt.); A. C. Baker (Royal Naval Air Service); R. G. Barton (P.O. Royal Naval Air Service); W. H. Bradbury (Calcutta Volunteer Rifles); R. V. C. Brook (Lieut. R.N.V.R.); R. Bruce (Lieut. R.E.); F. R. Bullard (2nd Lieut. 2/1st Derbyshire Yeomanry); A. E. Clarke (6th Manchester Regt.); W. H. C. Coates (2nd Lieut. R.F.A.); P. Colbeck (Capt. 6th Northumberland Fusiliers); J. Coxon (Lieut. R.E.); F. B. Cramer (Capt. R.M.); W. H. Edridge (A.S.C.); U. A. Farrell (C.P.O. Royal Navy); G. F. Findley (Instructor in Field Telegraphy and Telephony R.G.A.); E. W. Fleming (6th Cameron Highlanders); R. Francies (London Electrical Engineers, R.E.); W. E. French (Lieut. 17th West Yorkshire Regt.); C. C. Garland (Divisional Engineers, R.N.D.); A. C. Gilling (2nd Lieut. R.F.C.); C. N. M. Hamilton (2nd Lieut. R.G.A.); J. S. Hasdell (R.F.C.); C. H. Hayward (Lieut. R.N.V.R.); G. S Helme (2nd Lieut. Highland Brigade, R.F.A.); L. A. Hoyle (H.A.C.); T. C. Hunt (2nd Lieut. R.E.); H. T. Jager (Cossipore Artillery Volunteers); J. Lloyd (2nd Lieut. Jamaica Reserve Regt.); A. Lockwood (6th Royal Welsh Fusiliers); A. R. Low (Lieut. R.N.V.R.); H. F. McLoughlin (2nd Lieut. 10th East Lancashire Regt.); L. C. Martin (London University O.T.C.); J. Meredith (Inns of Court O.T.C.); R. M. Moberly (2nd Lieut. East Riding (Fortress) R.E.); E. P. Neate (2nd Lieut. R.E.); C. E. F. Parker (2nd Lieut. 2/2nd Monmouthshire Regt.); J. Parkinson (Lieut. R.E.); C. S. Perry (Lieut. Inland Water Transport Corps, R.E.); N. D. B. Phillips (2nd Lieut. Glamorgan (Fortress) R.E.); H. W. Pink (2nd Lieut. Hampshire (Fortress) R.E.); W. G. T. Pope (2nd Lieut. R.E.); C. Powell (2nd Lieut. Lowland Divisional R.E.); H. W. Powell (P.O. R.N.A.S.); G. G. L. Preece (2nd Lieut. Lancashire Fusiliers); M. E. Pyser (R.E.); S. Ransom (2nd Lieut. R.F.C., Wireless Section); H. Robertson (A.S.C.); R. P. Russell (2nd Lieut. R.E.); C. W. Salt (London Electrical Engineers, R.E.); E. J. Saner (Capt. 2/5th Bedfordshire Regt.); P. M. Sanger (H.A.C.); G. H. Sargent (2nd Lieut. A.S.C.); W. Balfour Smith (R.F.C.); A. H. Smyth (Lieut. A.O.C.); A. R. Stelling (2nd Lieut. 3/1st North Midland Divisional R.E.); E. J. Stiell (2nd Lieut. R.E.); F. B. C. Sutthery (Lieut. Tyne Electrical Engineers, R.E.); J. Tronche (Brigadier French Army); H. G. Trust (2nd Lieut. Intelligence Corps); H. C. C. Tufnell (Capt. London Electrical Engineers, R.E.); F. R. Unwin (Lieut. R.E.); Dr. T. F. Wall (Lieut. R.N.V.R.); E. J. Ward (2nd Lieut. 3rd Royal Irish Regt.); H. Watson (9th Scottish Provisional Batt.); G. H. Wilson (2nd Lieut. R.E.).

ASSOCIATES.

W. H. Cottrell (Commander R.N.V.R.); Rev. T. W. Foinette

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Dec. 30th, 1915

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

4,585/15. **Feeder Protection.** F. H. BOWDEN and H. F. J. THOMSON. A system of protection of cables of the kind having an insulated conductive shield separating the main conductors from one another and also a similar shield surrounding the whole of the main conductors. The shields are maintained at a potential different from earth; a relay is connected in a circuit supplying the potential to the shields, and is arranged to cut out any faulty lengths of cable. (Four figures.)

11,555/15. **Wireless Telegraphy.** F. K. VREELAND. A method of producing undamped oscillations by means of a mercury vapour arc. In order to obtain more intense action, the arc is concentrated into a powerful stream owing to the presence of inert gases within the bulb. (Two figures.)

14,918/15. **High Vacua.** SIEMENS & HALSKE A.G. A vacuum initially produced by a mechanical pump is increased or regulated by a method depending on the "blowing" or repulsive action of heated surfaces whereby molecules of residual gas can be given a mean velocity greater in one direction than in another, and thus propelled from one space to another. (Seven figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: HUGHES [Arc lamps] 24,335/14.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: ROSSELLI [Cable armouring] 7,607/15.

Heating and Cooking: GERAUD [Rivet heaters, welders, &c.] 8,449/15.

Ignition: SOUTH METROPOLITAN GAS CO. and BUCKETT [Electric ignition device for gas burners] 3,690/15.

Instruments and Meters: B.T.-H. CO. (*G.E. Co., U.S.A.*) [Permanent magnets for meters] 23,938/14 and [Thermal instruments] 24,169/14.

Switchgear, Fuses and Fittings: CURTIS [Resistances] 24,552/14; GROCUTT [Ceiling roses, &c.] 3,241/14.

Telephony and Telegraphy: ROUZET [Regulating oscillation transformers] 22,609/14; MARCONI'S WIRELESS TELEGRAPH CO. & MITCHELL [Condensers] 5,371/15.

Traction: MEYER [Trolley poles or bows] 24,074/14.

Miscellaneous: SOC. ANON. DES ETABLISSEMENTS L. BLERIOT [Regulation of installations] 20,505/13; SIEMENS-SCHUCKERTWERKE-GES. [Safety devices] 722/15; BRITISH WESTINGHOUSE ELEC. & MFG. CO. (*Westinghouse Elec. & Mfg. Co., U.S.A.*) [Vapour electric apparatus] 13,618/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos, Motors, &c.: MASCHINENFABRIK OERLIKON [Braking of motors] 17,419/15.

Telephony: SEELAU & NEWMAN [Phonographically recording telephone messages] 16,149/15.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: E. A. CLAREMONT [Junction boxes] 20,639/07.

Dynamos, Motors and Transformers: B.T.-H. CO. (*G.E. Co., U.S.A.*) [Transformers] 20,395/06; H. C. E. JACOBY [Motor control] 20,495/07 and 27,967/08.

Electrochemistry and Electrometallurgy: S. Z. DE FERRANTI [Arc furnaces for gaseous reactions] 20,692/07.

Ignition: A. J. BOULT (*L. Macquaire*) [Sparking plugs] 18,832/05.

Incandescent Lamps: V. SCHOLZ [Straightening of metal filaments] 20,372/07

Switchgear, Fuses, and Fittings: A.E.G. [Locking device for multiple contact switches] 20,229/07; B.T.-H. CO. (*G. E. Co., U.S.A.*) [Controllers] 20,397/07.

Telephony and Telegraphy: SIEMENS BROTHERS & CO., LTD. (*Siemens & Halske*) [Automatic telephones] 19,309/08.

New System of Numbering of Specifications.—It is announced by the Patent Office that applications for patents made subsequent to 1915 will be given new numbers when their complete specifications are accepted or become open to public inspection before acceptance. The new numbers will start with No. 100,001 (without any indication of date), and will supersede the original application numbers in all proceedings after acceptance of the complete specifications. It is intended in future to issue abridgments of specifications in the *Patent Office Journal* only a few weeks later than that in which their acceptance or publication is advertised.

(A.O.C.); N. McL. Lawrance (2nd Lieut. 2/4th East Anglian Brigade, R.F.A.); C. N. Nettley (C.P.O. R.N.A.S.); G. R. Rosevere (Lieut. A.O.C.); L. S. Simpson (Capt. R.E.); M. H. Vickerman (2nd Lieut. A.S.C.); C. L. Watson (2nd Lieut. R.E.).

GRADUATES.

H. M. Bamford (Lieut. Divisional Engineers, R.N.D.); E. G. Black (Eng. Lieut. R.N.R.); H. Butler (2nd Lieut. 11th Yorkshire Regt.); H. W. Curling (2nd Lieut. A.S.C.); W. R. Dainty (Flight-Sub-Lieut. R.N.A.S.); R. Gray (2nd Lieut. R.F.A.); H. R. L. Groom (2nd Lieut. 1/5th Royal Warwickshire Regt.); W. T. Hilder (London Electrical Engineers, R.E.); E. F. Jones (2nd Lieut. R.F.A.); S. A. Laird (2nd Lieut. R.F.C.); F. J. McC. Nibloe (London Electrical Engineers, R.E.); T. C. Richardson (Capt. R.E.); C. H. Sparks (Lieut. R.F.A.); W. G. P. Wall (Naini Tal Volunteer Rifles); F. W. J. West (Royal Bucks Hussars).

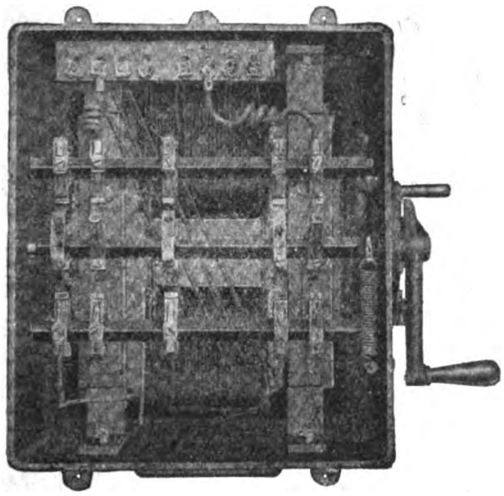
STUDENTS.

R. C. Andersen (2nd Lieut. London Divisional R.E.); W. M. Baxter (R.N.A.S.); T. B. Berry (2nd Lieut. R.E.); J. A. A. Best (London Electrical Engineers, R.E.); E. E. Birch (Sub-Lieut. R.N.R.); C. L. Bunt (Lieut. 4th Duke of Cornwall's Light Infantry); J. W. P. Chalmers (Lieut. R.E.); J. Cheshire (3rd Manchester Regt.); N. H. Cole (R.F.C.); C. R. Cosens (Lieut. R.E.); W. G. Cross (13th Liverpool Regt.); A. R. Dawes (London Electrical Engineers, R.E.); R. R. Dawes (6th Manchester Regt.); B. Dennis (University of London O.T.C.); C. Derry (2nd Lieut. A.S.C.); W. G. Edwards (2nd Lieut. Tyne Electrical Engineers, R.E.); D. Gill (Sub-Lieut. R.N.A.S.); E. H. Glover (2nd Lieut. R.E.); L. A. Gripper (R.A.M.C.); L. E. H. Harris (26th Batt., Australian Force); L. W. Hayes (P.O. R.N.A.S.); F. J. Heyes (2nd Lieut. Royal Anglesey R.E.); R. M. C. Holland-Pryor (Sub-Lieut. R.N.); W. G. Johnson (2nd Lieut. R.E.); J. W. Jones (2nd Lieut. East Lancashire R.E.); W. H. P. Kerman (R.N.A.S.); C. H. Keith (Lieut. R.N.A.S.); S. G. Killingback (2nd Lieut. R.E.); L. S. King (London Electrical Engineers, R.E.); F. C. Lawrence (2nd Lieut. 14th West Yorkshire Regt.); J. H. Lee (2nd Lieut. 2/4th Yorkshire Regt.); A. H. Leeves (2nd Lieut. 3/1st East Lancashire R.E.); W. F. Lloyd (London Electrical Engineers, R.E.); D. W. Low (Lieut. R.N.V.R.); E. G. Mabbs R.A.M.C.); V. H. M. McMahon (A.S.C.); C. W. W. Manlove (2nd Lieut. Kent (Fortress) R.E.); R. R. G. Mann (2nd Lieut. R.E.); H. T. Moody (London Electrical Engineers, R.E.); L. E. R. Murray (Flight Sub-Lieut. R.N.A.S.); A. S. Padgett (6th Manchester Regt.); L. C. Pocock (Anglo-Russian Hospital); W. J. Rawlings (2nd Lieut. London Electrical Engineers, R.E.); G. A. Rendle (2nd Lieut. 14th Royal Fusiliers); W. H. Shaw (R.E.); R. A. Shiell (London Scottish); C. P. Smith (London Electrical Engineers, R.E.); W. W. Stainer (2nd Lieut. Royal Sussex Regt.); C. R. F. Taylor (R.F.C.); C. E. Tolley (Wessex Divisional R.E.); J. G. L. Welch (2nd Lieut. R.G.A.); A. C. Yeates (Eng. Lieut. R.N.); H. V. Young (Inns of Court O.T.C.).

A 100,000-volt Distribution Scheme.—The German electrical papers contain particulars of a scheme authorised by the Bavarian Government for the reconstruction of the electric supply system of South-Western Bavaria. A company with 31 million marks capital is to be formed, and the scheme will embrace the whole of the existing electricity works in the area in question, and a new water-power station which is to be built on the Walchensee. A 100,000-volt network is to be erected, and the city of Munich is to be one of the numerous consumers. Part of the necessary capital will be supplied by the Government.

"WITTON" MOTOR STARTERS AND CONTROLLERS

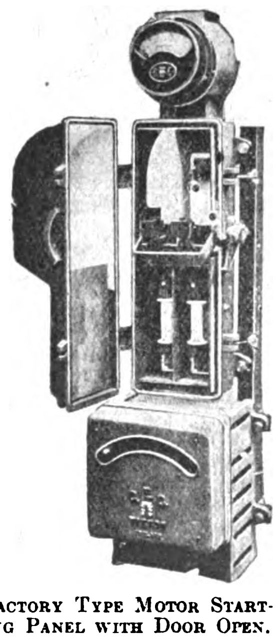
NOW that electric motors, to the extent of millions of horse-power have been put into commission on war work, in addition to the very large number previously running in the older factories and workshops, the question of the supply at short notice of motor starters and controllers is a most pressing one. The latest G.E.C. catalogue of "Witton" starters, controllers, and regulators which has just been sent us for review appears, therefore, at a very appropriate time, especially as the Company states that it



MISTAKE-PROOF AUTO-TRANSFORMER STARTER.

is in a position to supply from stock all kinds of open, enclosed, and semi-enclosed starters for continuous-current motors listed, as well as the plain rotor starters for three-phase motors. The latter comprise adjustable three-phase resistances for the rotor circuit, without any automatic features, mounted somewhat similarly to those used in "Witton" standard D.C. starters. The resistances pass approximately full load current on the first contact, and thus start the motor against full load torque. "Off" contacts are provided, and a spring return and "on" catch may also be fitted at a slightly increased price. The starter-arm

INTERIOR VIEW OF CONTROLLER, SIZE 1 AR.



FACTORY TYPE MOTOR STARTING PANEL WITH DOOR OPEN.

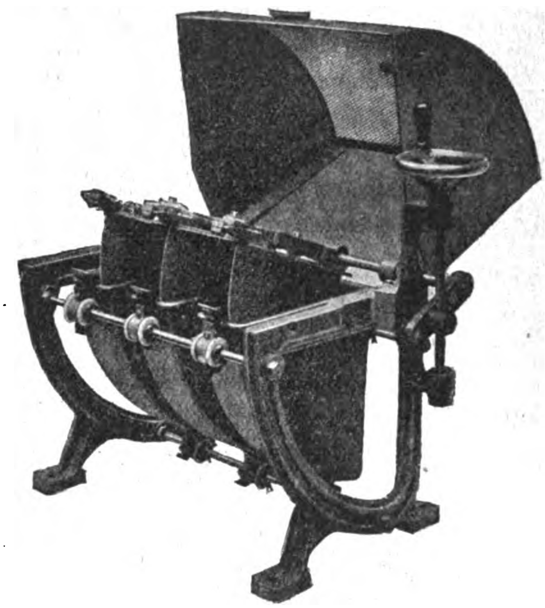
is then held in the "full on" position by a catch against the tension of a spring, and flies to the "off" position on pressing a knob.

For starting three-phase "squirrel-cage" motors against loads not exceeding half full load torque, "Witton" star-delta drum type starters are recommended, applying the full line voltage to the motor windings when running, but only about 0·866 of the full line voltage at starting. The "starting," "running," and "off" positions follow one another consecutively, so that it is impossible to go from the "off" to the "running" position without passing the "starting" stop, and an arrangement is provided which definitely marks each position. These starters are suitable for motors taking a line current up to 50 amperes at 550 volts.

Where squirrel-cage motors have to start against a greater torque than half full load torque, an auto-transformer starter should be employed. "Witton" auto-transformer starters comprise an auto-transformer with tappings giving a voltage of 40 per cent., 60 per cent., 70 per cent., and 80 per cent. of the full line voltage, together with a change-over switch, the whole being enclosed in a cast-iron case and operated by an external handle. The transformer can be oil-immersed.

The "Witton" liquid starter for continuous or alternating current motors is also listed, and we understand arrangements have been made to hold a large stock of finished parts.

In both A.C. and D.C. work it is a very great advantage in most cases to be able to reduce the labour of erection and connecting up on site. The "Dockyard" and "Factory" types of "Witton" motor starting panels have been developed with this end in view. They consist of a Salford switch and fuse (two-pole for D.C. and three-pole for A.C.), an ammeter totally enclosed in the "Dockyard" and open in



LIQUID STARTER FOR USE IN DUST-LADEN ATMOSPHERES.

the "Factory" type, and one D.C. or star-delta starter, totally enclosed in the "Dockyard" and semi-enclosed in the "Factory" type. The panel is simply bolted in position on site and connected to the motor by three leads.

For the control of small cranes the 1 AR controllers which we illustrate are suitable. The drum is of cast-iron fixed rigidly to a steel shaft, with hard drawn copper contacts screwed on, and the cover is of sheet steel. They can be supplied either with crank handles or rope wheel. The resistances, which are mounted inside the case, are carried on insulating tubes threaded on vertical steel conduits, which are insulated from the case by porcelain insulators and arranged well away from the arcing parts. Above 3 h.p. 200–250 volts or 5 h.p. 420–500 volts the resistance is separate, and a magnetic blow-out is provided.

In addition to the foregoing, other controllers and controller resistances are listed, as are automatic motor starters, iron-clad reversing switches, shunt regulators, main regulators, multiple switch starters, single-phase motor starters, &c.

These motor starters are all manufactured by the General Electric Co., Ltd., at "Witton" Works, Birmingham.

Obituary.—In the death of Mr. H. A. Taylor, at the age of seventy-six, another link with the earliest days of the electrical industry has been severed. His firm of Clark, Forde & Taylor built up a reputation in connection with submarine cable work quite unique, and Mr. Taylor's association with the late Mr. Latimer Clark, F.R.S., and others, in the days when the electrical industry consisted almost solely of telegraph work, was productive of many important improvements in this branch of the industry. These, though not appealing to the popular imagination to quite the same degree as some of the later developments in other directions, have, nevertheless, exerted an enormous influence upon the commercial life of the world. He became a member of the Institution in 1872, and has served on the Council.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Birmingham.—Extensions are to be made to the temporary power station at Nechells at an estimated cost of £100,000. We described this temporary power station in our issue for August 19th, 1915, p. 346, but since then the demand has increased so enormously that whereas the plant originally installed was expected to carry the undertaking along until the spring of 1917, it has been found that it will not do so beyond the present winter.

Erith.—The Council is arranging for a bulk supply to 200 houses on the Colyers Lane Estate from the West Kent Electric Co.

Finchley.—Application is to be made to the Local Government Board for a loan of £10,000 for plant extensions.

Hereford.—The Local Government Board has once more refused the Council a loan to instal a new generating station, but having regard to the nature of the demands now being made upon the undertaking, a further application for a loan is to be made.

Leek.—An application is to be made to the Local Government Board for a loan for an additional generating station.

New Zealand.—A 40-kw. hydro-electric generating set, switchboard, &c., is required for Raetihi. Tenders to Clerk by March 14th. Further particulars at 73 Basinghall Street, London, E.C.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. Wiring contractors are recommended to make inquiries to ascertain whether electrical work will be required.

Govan.—New secondary school. Architect, Mr. Matthew Adam, 160 Hope Street, Glasgow.

Mossley.—New mills for Messrs. Bottomley.

Newcastle-on-Tyne.—Cinematograph hall, Back Street.

Miscellaneous

Croydon.—The Tramways Department require twelve months' supply of electrical goods. Manager. January 24th.

Dublin.—The Port and Docks Board require a twelve months' supply of electrical goods. Tenders to the Secretary, Westmoreland Street, by January 12th.

APPOINTMENTS AND PERSONAL NOTES

Mr. A. Schneider, a British-born subject and Managing Director to Messrs. Evershed & Vignoles, Ltd., has adopted the name of Vines.

Mr. J. B. Feltham, assistant electrical engineer to the Gloucester Corporation, has been appointed borough electrical engineer at Mexborough in succession to Mr. John Senior, who recently resigned.

Dr. F. S. Pearson, head of the group of financiers controlling the Brazilian and Mexican tramways and electric power companies, who lost his life in the sinking of the *Lusitania* in May last, left estate in the United Kingdom of the gross value of £328,860.

The Birmingham Electricity Supply Department want a shift engineer. (See an advertisement on another page.)

LOCAL NOTES

Chelmsford: *Proposed Purchase of Supply Company.*—The Town Clerk, reporting upon the question of purchasing the undertaking of the Electric Supply Corporation in the town, states that it would be futile at the present time to apply to the Local Government Board for sanction for borrowing the necessary money. He suggested that an application should be made to the Local Government Board to extend the time within which the Council may exercise its option, and the Council has agreed to do this.

Keighley: *Heating of Factories.*—The Steel Tubes & Conduits Co., of Keighley, manufacturers of electrical fittings, were fined 50s. in the local police court last week for failing to maintain a reasonable temperature in their factories. One of H.M. Inspectors of Factories stated that on November 29th the temperature was only 35 degrees half an hour after the employees had commenced work. The Home Office considered the case so important that the Medical Officer of the Department, Dr. T. M. Legge, was sent to Keighley to give evidence. He expressed the opinion that a temperature of 60 degrees is the minimum which should be maintained in a factory where the employees are not moving about or doing physical exercise. The defendants did not dispute the facts, but said that since their attention had been called to the matter steps had been taken to comply with the regulations.

London: *Blackheath: Death from Electric Shock.*—Last week a driver in the Army Service Corps became entangled in some electrical mains which had been blown down from their poles in the camp at Blackheath, and received such a serious electric shock that he died from the effects of it.

Tasmania: *The Water Power Scheme.*—Now that the Government has taken over the Great Lakes electric power scheme, attention is being given to the question of its commercial development. Mr. H. A. Curtis, who at present occupies the post of operating engineer of the New Zealand Government's Lake Coleridge scheme, has been appointed station superintendent, together with three operating engineers. Considerable activity is being shown on the publicity side, and an electrical exhibition has been held in the City Hall.

York: *Extension of Time.*—The City Council is to apply for an extension of time in which to lay the mains authorised under the Electric Lighting Order granted in 1914 dealing with Bishopsthorpe and Acomb districts.

CALENDARS, &c.

Pope's Electric Lamp Co., Ltd. (Hythe Road, Willesden), have sent us a useful monthly tear-off wall calendar. The lettering being black upon a white background renders the location of any particular date an easy matter.

From the United States Metallic Packing Co., Ltd. (Soho Works, Bradford, Yorkshire), there comes another artistic calendar of the series they have now issued for several years. The picture this year is one of "Victory" in bas relief.

The Langdon Davies Motor Co., of 110 Cannon Street, London, E.C., has broken away from convention this year, and has sent to its friends not a diary, but a note-book, measuring 5½ ins. by 3 ins. This is well bound in a plain, stiff cover with pencil at the back, and in place of the usual postal information, &c., there are a number of useful tables, as well as particulars of some of the firm's standard sizes and types of motors.

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic copper bars, c.i.f. port of arrival, quoted on Tuesday night was £110 to £112 (last week, £106 to £108).

Arrangements for the Week.—*Friday, Jan. 7th.*—Electro-Harmonic Society Smoking Concert, Holborn Restaurant, 8 p.m.

Monday, Jan. 10th.—Institution of Electrical Engineers, Newcastle Section, at Mining Institute: "The Design of High-pressure Distribution Systems," by J. R. Beard, 7.30 p.m.

Tuesday, Jan. 11th.—Institution of Electrical Engineers, Scottish Section, 207 Bath Street, Glasgow: "Distribution and Rise of Temperature in Field Coils" (Part. II.), by Prof. M. Maclean and W. J. MacKellar, 8 p.m.—Manchester Section at Engineers' Club, Albert Square: "The Predetermination of the Performance of Dynamo-electric Machinery," by Prof. Miles Walker, 7.30 p.m.

Illuminating Engineering Society at Royal Society of Arts: Discussion on "Some Principles in Industrial Lighting (with special reference to the first report of the Home Office Committee on Lighting in Factories and Workshops)," 8 p.m.

Wednesday, Jan. 12th.—Institution of Electrical Engineers, Birmingham Section, at the University, 7 p.m.—Yorkshire Section at Philosophical Hall, Leeds: "The Design of High-pressure Distribution Systems," by J. R. Beard, 7 p.m.

Thursday, Jan. 13th.—Institution of Electrical Engineers: "The Predetermination of the Performance of Dynamo-electric Machinery," by Prof. Miles Walker, 8 p.m.

ELECTRICAL ENGINEERING

With which is Incorporated

THE ELECTRICAL ENGINEER

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SUMMARY

A PAPER on the "The Predetermination of the Performance of Dynamo-electric Machinery" was read before the Institution of Electrical Engineers at Manchester on Tuesday, and at Birmingham yesterday, by Professor Miles Walker, who will also read it in London to-day. A method of design applicable to all classes of dynamo-electric machines was discussed (p. 12).

A PAPER on "Electric Generating Stations in China" has been read by Prof. C. A. Middleton Smith before the Hong-Kong Local Centre, and is published in the Institution *Journal*. The author is of opinion that the present demand for electrical apparatus in China is comparatively small, but that prospects for the future are more promising (p. 12).

THE general principles of electric lift construction were ably dealt with in a practical paper read by Mr. H. Marryat last month before the Association of Supervising Electricians. Figures were given also to show the extremely low running cost of electric as compared with hydraulic lifts (p. 13).

A PAPER by Mr. F. W. Carter on "The Electric Locomotive" was read on Tuesday, Jan. 11th, at the Institution of Civil Engineers. The author discussed the electric locomotive particularly from the point of view of its mechanical features (p. 14).

WE review books on steam power plant testing and wireless telegraphy (p. 15).

AN interesting breakdown in a hydro-electric powerhouse supplying a section of the Bavarian State Railways was caused by the rapid action of the governor, on the tripping of a feeder switch at full load, bursting the casing of a turbine and flooding the generating plant (p. 15).

AMONG the subjects of specifications published at the Patent Office on Thursday were thermal demand indicators and cable armouring. Patents relating to tramway points, telegraphy, and magnetic ignition for gas engines expire this week after a full life of fourteen years (p. 16).

AT a recent meeting of the Liverpool Engineering Society, Mr. C. E. Jones reviewed some points observed in the design of ships' installations. He recommended the use of 3-wire generators (p. 16).

OUR Questions and Answers page this week deals with the best method of making extensions in the wiring of an electric bell circuit (p. 17).

A NOVELTY in the form of a conduit wiring gauge has been distributed by Simplex Conduits, Ltd.—A new insulating lamp-holder is also described (p. 18).

EXTENSIONS estimated to cost £14,000 are contemplated at Bo'ness; sub-station converters, traction boosters, &c., are required at Manchester; electrical stores at Pembroke (Ireland); large quantities of electric lamps by the S. African Rly. Headquarters, and new plant at Stockton-on-Tees and Leicester (p. 19).

COAL troubles are being experienced at St. Anne's-on-Sea.—A 20 per cent. increase is to be made in the charges for electricity at Lincoln.—Further bulk supply is to be taken by Stockton Corporation from the Cleveland & Durham Electric Power Co., in preference to putting down a new generating set (p. 19).

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

COMPANY ORDERS BY LIEUT.-COL. C. B. CLAY, V.D., COMMANDING.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

(To-day) Thurs., Jan. 13th: Shooting for Sections I. and II., and signalling section.

Fri., Jan. 14th: Sections III. and IV., technical. Sections I. and II., squad. Signalling section and recruits.

Sat., Jan. 15th: Uniform parade; 2.45 p.m., Chester House.

Mon., Jan. 17th: Sections I. and II., technical. Sections III. and 4, squad. Signalling section and recruits.

Tues., Jan. 18th: School of arms, 6.0 to 7.0 p.m.

Thurs., Jan. 20th: Shooting for Sections III. and IV.

Fri., Jan. 21st: Sections III. and IV., technical. Sections I. and II., squad. Signalling section and recruits.

Sections for technical parade at Headquarters, London Electrical Engineers, 46 Regency Street, S.W.

Sections for shooting parade at miniature ranges.

Unless otherwise ordered, all parades at Chester House.

Arrangements for the Week.—*(To-day) Thursday, Jan. 13th.*—Institution of Electrical Engineers: "The Predetermination of the Performance of Dynamo-electric Machinery," by Prof. Miles Walker, 8 p.m.

Saturday, Jan. 15th.—Birmingham & District Electric Club, Swan Hotel, New Street: "The Manufacture and Performance of Electric Incandescent Lamps," by A. Johnson, 7 p.m.

Wednesday, Jan. 19th.—Diesel Engine Users' Association at I.E.E., Victoria Embankment: discussion on "The Possible Use of Tar Oils and Fuel Oils from Other Sources."

Thursday, Jan. 20th.—Institution of Electrical Engineers: "The Principles of Modern Printing Telegraphy," by H. H. Harrison.

PREDETERMINING THE PERFORMANCE OF DYNAMO-ELECTRIC MACHINERY

PROFESSOR MILES WALKER, in his Paper on this subject, read before the Institution of Electrical Engineers at Manchester on Tuesday, and to be read in London to-day, discusses some of the principles underlying the design of all electrical machines, and shows the application of these principles by two particular examples. The methods described in text-books and in articles published in the technical journals can be broadly divided into two classes :—(1) Those on the basis of the total flux per pole; and (2) those on the basis of the maximum flux density in the air-gap. The first method has the advantage that, after fixing the form factor, it only deals with the total flux without troubling about the distribution of the lines of force in the air-gap; but this very feature limits its application to those cases where we are content to know the mean electromotive force generated.

Professor Walker shows how it is possible to have a combination of these methods which preserves the advantages of both, and he develops the formula

$$E_g = K_e \times R_{pm} \times Z_a \times A_g B \times (1/60) \times 10^{-8},$$

for the E.M.F. of an alternator. By the use of a suitable coefficient, K_e, this formula can be used for the E.M.F. generated in any dynamo-electric machine; and for general use it has the following advantages in its favour :—

(1) The formula contains the term B, representing the maximum value of the flux density in the air-gap, and for many reasons it is well to have this quantity continually before us.

(2) The expression A_g B, the maximum flux density multiplied by the total area of the active surface of the armature, has a fairly definite maximum value for a given frame or carcase; so that if we are familiar with our frame we know by a glance at our calculation to what extent we are making good use of the material. For instance, if we have an armature of an alternating-current generator having a diameter of 150 cm. and a length of 30 cm., then $A_g = \pi \times 150 \times 30 = 14{,}160$; and if we know from experience that B in the air-gap cannot be made higher than 10,000 C.G.S. lines per sq. cm., the maximum value of A_g B for that frame would be $1{\cdot}4 \times 10^8$.

As this quantity, A_g B, is almost independent of the number of poles, the designer soon comes to know the value it should have for any particular frame, and is able to judge at a glance how far he is utilising the magnetic circuit.

(3) The maximum flux density in the teeth can be found by dividing A_g B by the total section of all the teeth. This is a shorter and more convenient method than that employed where the total flux per pole is taken as the basis of calculation. In the latter case it is necessary to make an estimate of the virtual number of teeth per pole, and this is not a simple matter when the pole is bevelled.

(4) The coefficient K_e has a certain recognised maximum value for a certain kind of machine. Thus, for a 3-phase generator, K_e may be equal to 0·4. If it has a lower value in any calculation under consideration (as may be the case where the pole-arc is a small fraction of the pole-pitch), the designer's attention is called to that circumstance.

(5) If we multiply both sides of the above equation by I_a, the current in the armature conductors, we get a formula for the output, containing the two expressions :

A_gB, the magnetic loading; and

$I_a Z_a$, the current loading.

Both these quantities being clearly before us during our consideration of alternative designs, we can observe how one decreases and the other increases in the fight for room which occurs between iron and copper.

The author gives a general method of design applicable to all classes of machines, and illustrates it by applying it to a three-phase turbo-generator and an inductor motor. These two designs are worked out in detail and the results tabulated on a calculation form which is applicable to any type of dynamo-electric machine. Six appendices are given in the Paper, describing respectively the author's methods of calculating the field-form of a turbo-generator having highly saturated teeth, E.M.F. coefficient, magnetising current, armature reaction, copper and iron losses, and temperature rise.

Gas and the Generation of Electricity.—At the annual meeting of British Coalite, Ltd., recently, it was stated that negotiations are in progress with the County of London Electric Supply Co. for the latter to take a supply of gas for generating electricity when their new power station is built at Barking. Similarly, before the war, negotiations were in progress with one of the largest of the London Municipalities for the construction of a Coalite plant capable of dealing with 500 tons of coal per day, the whole of the gas generated from which was to be utilised in the Borough Council's electricity undertaking.

PROSPECTS OF THE ELECTRICAL INDUSTRY IN CHINA

SOME interesting facts which give one an insight into the present condition of electrical engineering in China are given in a Paper published in the *Journal* of the Institution of Electrical Engineers on "Electric Generating Stations in China." The Paper was read before the Hong Kong Local Centre by Professor C. A. Middleton Smith, of Hong Kong University. In the whole of China there are only three places in which modern industrialism is even attempted on any scale. These are Hong Kong, Shanghai, and Hankow. In Hong Kong the two outstanding features are the public works and the three large dockyards, the latter employing about 600 European managers, engineers, foremen, &c., and about 7,000 Chinese workmen. These dockyards are well equipped with all modern machine tools, many of which are motor-driven in accordance with the most modern practice. The Taikoo Dockyard power station contains 1,000-b.h.p. gas engines, and continuous-current generators with a total capacity of 2,250 kw. The Hong Kong and Whampoa Dock Co. has a steam-driven central station of 500-kw. capacity, which, it is understood, will be abolished and a bulk supply of energy taken from the local supply company. The Naval Dockyard has its own central station with steam and Diesel engines.

In Hong Kong there are also two public supply companies. One, which supplies the city of Victoria, has a station containing 2,000 kw. of Diesel engines and 600 kw. of steam engines, but it is being re-designed for steam turbine sets. The price of energy is 6d. for lighting and 1½d. for power. The other company, the China Light & Power Co., have plant rated at 516 kw., but 1,500 kw. was to be installed in 1915.

About forty-five miles from Hong Kong is the Canton Electric Supply Co., with 1,540 kw. of plant, which is rapidly growing. Canton is the most populous, and is usually regarded as the most progressive city in China. There are well over 1,000,000 inhabitants.

The great centre of electrical development in China is Shanghai, and any British engineer who has visited the Far East must be impressed by the remarkable progress made here. The Shanghai generating station compares most favourably with anything of its kind in Europe or America. It is steam-driven with two 5,000 kw. and two 2,000-kw. turbines All the latest mechanical coal-handling devices, &c., are employed. The station has been carefully planned for large extensions, the scale of which may be judged when it is mentioned that quite recently the chief engineer suggested extensions amounting to 20,000 kw., and costing about £200,000.

Mention must also be made, said the author, of the industrial development of Hankow and of other places in the valley of the Yangtse-Kiang River. It is almost certain that this region will be the first part of China to develop works and factories on a large scale, but it must not be forgotten that the Cantonese have, among the Chinese, the greatest reputation for enterprise and business instinct.

Some indication of the development of electrical business in China was to be seen from the following examples of contracts obtained by four European firms. An English firm has installed 102 steam engines in China, with a total rating of 28,960 b.h.p. Most of these are used for electricity supply. Another British firm has installed at Soochow a 375-kw. three-phase alternator direct coupled to a high-speed steam engine, complete with high-tension switchboard, &c.; at Tientsin, two 75-kw. continuous curent sets; at another town, one 200-kw. and one 150-kw. alternator for lighting; also a large number of A.C. motors from 5 to 100 h.p. for use in cotton mills and other factories, and many small sets. A merchant firm has supplied various lighting installations in South China as follows :—For Canton, one 60-kw. continuous-current set; at Shek-Ki, one 30-kw. set; at Kongmoon, one 40 kw. set; and a large number of private plants. A large European firm has supplied :—One 140-kw. Diesel single-phase set for the Canton Electric Supply Co., and a 750-kw. alternator for the same company; four 200-kw. Diesel 3,000-volt three-phase sets for the Macao Electric Light Co., in Yunanfu, two water-turbine sets, each of 300-kw. capacity; and several large turbo-alternators in North China, at Pekin, Changsha, Tsingtau, Pingshing, and other places.

Employment of Disabled Sailors and Soldiers.—The Council of the Institution of Electrical Engineers have requested the National Service Committee of the Institution to formulate a scheme for giving to disabled sailors and soldiers a preliminary training as switchboard attendants, &c., and for obtaining means to carry on this work and arranging for the selection and distribution of applicants for positions.

ELECTRIC LIFTS

A VALUABLE and intensely practical Paper on electric lifts was read by Mr. H. Marryat before the Association of Supervising Electricians last month. At the commencement of his Paper he insisted on the importance of having the same margin of safety and the same safety devices on goods lifts as on passenger lifts, unless the goods lift is strictly a service lift, so constructed that a passenger cannot possibly enter it. He next explained that lift counterweights are usually made to correspond with the weight of the lift plus 40 per cent. of the full load, so that when carrying 40 per cent. of their load they require very little power either when ascending or descending. It is for this reason that the running costs of electric lifts are so much less than those of hydraulic lifts, for the latter use the same quantity of water whatever the load. Mr. Marryat's experience is that the cost of current for a modern electric lift is about one-tenth of the water bill for a hydraulic lift of the same size. The first cost of the two lifts is about the same. Observations which he has taken with four push-button lifts fitted with journey counters show an average of about 100 journeys per unit for a 6-cwt. passenger lift. Non-automatic lifts would, of course, consume slightly more, as the starting and stopping will not be performed with the same electrical efficiency by the lift attendant. The Westminster Electric Supply Corporation found that 50 lifts consumed only 58,000 units in 12 months' normal working.

In maintenance costs the author estimated that an electric hand-rope or car-switch lift was 25 per cent. cheaper, and a push-button lift about the same as a hydraulic one. Mr. Marryat recommended supervising engineers to alter the counterweight by adding to or removing one or more of the cast-iron slips in its frame if the average load is more or less than the 40 per cent. allowed for. Considerable economies may be introduced in this way, but it must not be forgotten that this may reduce the maximum lifting power of the lift.

The author expressed a preference for top-gear rather than bottom-gear lifts. The length of the ropes is then only one-third that for a similar lift, with gear fixed at the foot of the well, and rope renewals form the most expensive part of the upkeep. If, however, a top-gear lift is to serve the top floor, a weather-proof house for it must be built upon the roof. The chief objection to top-gear is the possibility of noise and vibration being transmitted to the rest of the building. To prevent this, the bedplate may be anchored to a block of concrete of ample weight, which, in turn, is bedded upon sand, and isolated from walls and footings by more sand. A thin cover of soft asphalt may conveniently be used to cover the sand surrounding the concrete bed. In modern buildings of steel construction the difficulties arising from this source are greatly enhanced, and the author then recommends that if the gear be situated at the top of the well it should be mounted upon a heavy and non-resilient bedplate, the girders supporting which should be isolated from the masonry by means of large blocks of rubber. A double ceiling, padded with asbestos, slag, or other similar material, may, with advantage, be interposed between the gear and the well, the only openings in this ceiling being those for the ropes to pass through.

In calculating the capacity required of the motor, it is usual to allow 2½ times the actual theoretical maximum load, i.e., 2½ times the amount in pounds that the lift is out of balance when fully loaded, multiplied by the speed in feet per minute at which the lift travels, and divided by 33,000. The motor is then rated for intermittent working at this power.

The commutator and mechanical parts will have to sustain greater wear and tear than is usual in ordinary mill work, and should be designed more liberally. The motor should be compound wound with 10 per cent. to 15 per cent. of series field. Special attention should be given to the method of connecting the armature coils to the commutator, so that they shall resist the breaking action of the repeated and rapid reversal. The oil wells should be of ample capacity, because a lift may be left for a month at a time without skilled attention. When quiet running is essential, the motor-makers should be informed.

For speed reduction worm gear is preferred, not on the score of efficiency, but because of its extreme smoothness of running and its being to some extent self-sustaining; if the power fail, there is no chance of the load driving the motor through the gear at any very great speed. Another advantage is its compactness, and the fact that it provides a right-angled drive which, in most cases, is an advantage in the lay-out of a lift, with economy of space. The worm should be of steel, and cut solid with the shaft, *i.e.*, not keyed on. Liberally designed thrust washers must be provided to take the thrust from the worm wheel in each direction. Ball thrusts are now usually employed. The worm wheel is sometimes made of cast-iron, but more usually the rim is of phosphor bronze, or gun-metal, mounted upon a cast-iron centre. It is of the utmost importance that this attachment should be mechanically sound, as a number of accidents have occurred owing to the bolts getting loose or shearing. If the rim of the worm wheel gets free on its centre, all safety devices are cut out except only the dog grips on the car itself, and, as the ropes remain taut, these do not act.

The electric brake is usually placed between the worm gear and the motor, and the couplings between the two shafts form the brake drum. The brake is normally held on by springs, and pulled off by a magnet connected in parallel with the motor field.

The author prefers sheave lifts to drum lifts. In a sheave lift the ropes only pass a half-turn more or less round the driving sheave, the grooves of which are cut at such an angle as to give the necessary grip to the ropes with a minimum of distortion. In a drum lift the ropes are anchored to the drum at one end, and wind up upon it in a spiral groove cut upon its surface. The advantages claimed for the drum are, that owing to the grooves being made to the shape of the rope, instead of being Veed, the rope life is longer. This, he contends, is only the case provided the drum is large in diameter. A drum of the small diameter now usually employed is not so kind to the ropes as a sheave of the larger diameter, essential when the gear is situated at the top of the well and leading wheels are not employed. With a drum drive, however, a standard gear may be made up and used for lifts of different dimensions. An important disadvantage of the drum drive is the impossibility of slip, in case of over-running. If limit switches and safety devices fail, something must smash, as the ropes are positively driven from the drum. With a sheave lift, in the event of over-running either the car or the counterweight lands upon the buffers, and the tension being so removed from the ropes, the driving sheave can continue to revolve under the ropes with no risk of anything serious happening. A further advantage of the sheave is that there is practically no limit to the number of ropes which may be employed, whereas if a drum is to be kept to reasonable dimensions the number of ropes must be reduced to a minimum, in order to find room for them to coil on the drum. As a consequence it is usual to find four ropes to a sheave-driven lift, against two on a drum lift of similar capacity. To obtain equal strength, the ropes on the drum lift must be larger in diameter, and, in consequence, will suffer more from bending round the drum and leading wheels.

The driving sheave should be substantial, of the disc pattern, and not of the light-spoked variety, which is apt to develop cracks from no obvious cause whatever. The grooves must be cut with care to the exact angle to ensure correct driving, with minimum wear on the ropes. It is a frequent business to re-cut the grooves on the sheaves of old lifts coming under maintenance contract, in order to reduce the annual rope bill.

Leading wheels—that is, wheels to guide the ropes to the required position over car or counterweight—when they are necessary, should be provided with spindles giving ample bearing surface, and these should be well lubricated. These wheels often sustain great weight, and the designer, using a standard wheel, does not always stop to calculate the pressure in individual cases. Passenger lifts in this country are not usually designed for speeds exceeding 200 ft. per minute, but the tendency is to increase the rate of travel. In high buildings, speeds of 400 ft. per minute and upwards, with a correspondingly rapid acceleration, can be used with advantage, and in these cases it is advisable to carry the ropes round a leading wheel, and a second time over the driving wheel, in order to secure a greater tractive force.

The form of stranding for ropes found to be most satisfactory for all-round lift work is that known as "6/19," layed up round a hemp core. 6/24 and 6/30 give much greater flexibility, but the finer wires wear more quickly. A good rule for deciding upon the size of ropes required is to allow for a set of four ropes a breaking strain of six times full load upon each rope, and for a set of two ropes, a similar margin of seven times. Good ropes should not be grudged. The cost of labour in changing a set of ropes is often as much as the cost of the ropes themselves. When one rope in a set requires renewal, it is therefore economy to renew the whole set.

The car is supported by a sling of wrought-iron, and this carries four guiding shoes. These must be accurately shaped to fit the guides, and, preferably, be made or lined with gun-metal. They should be mounted upon spring boxes, so designed as to maintain them in constant and nicely-balanced pressure upon the guides, so that any uneven loading or swaying of the car will be automatically taken up. The pressure of the springs in the boxes should be capable of regulation.

Safety gear was next dealt with. The author has only known one case where a whole set of ropes has broken. It is more usual for the ropes to stretch, preparatory to breaking, as the result of excessive wear. In either of these contingencies the safety gear which is fixed to the car, and sometimes on the counterweight as well, must come into action.

This safety gear, in its most usual form, consists of cam-shaped wedges, mounted upon shafts, and stoutly attached to the sling, either below or above the car. The position of the wedges is such that they jam upon the guides and the greater the weight or force put upon them, the more securely do they support the car. Normally, they are held just clear of the guides by means of springs. A light cord is so attached to

the shafts that any tension upon the cord overcomes the springs and brings the cams into action. This safety cord is reeved with the ropes, and runs in a special groove provided for it over any sheaves the rope may traverse, and it is fastened off to the counterweight, so as to be slack so long as the main ropes do not unduly stretch or break. Should this happen, the weight upon the safety cord brings the safety gear into operation and holds the car suspended. An elaboration of this device, indicated in Fig. 1, is often fitted, which brings the safety gear into play if only one of the set of ropes stretches or breaks. These types of safety-gear were originally designed for wood guides. For larger lifts running upon steel guides, the safety gear usually takes the form of two pairs of powerful toggle pincers, which fasten their jaws upon the guides when called into service.

To prevent over-running, control limit switches are fixed in the well, at the top and bottom, so that should the car over-run in either direction, it will come into contact with one of the switches, and, operating it, short-circuit the main control solenoid, so causing the motor to stop and the brake to come on. This arrangement is not proof against certain faults on the controller itself, so it is usual and advisable to fix an additional limit switch, designed to open the main circuit, in

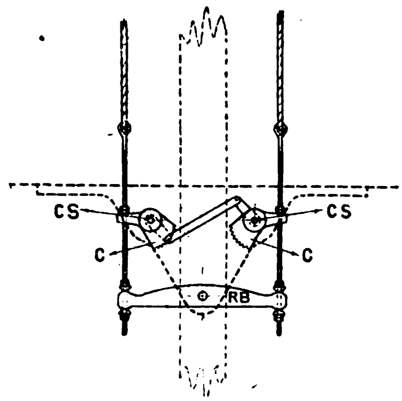


FIG. 1.

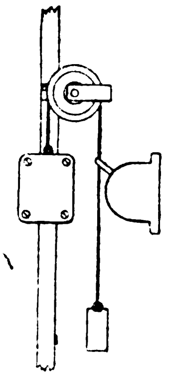


FIG. 2.

a position a few inches beyond the control limit switch in either direction. To save running the heavy main cables the whole length of the well, it is usual to fix only one such main limit switch, which is operated by both the car and the counterweight, should the lift over-run the prescribed distance (see Fig. 2). With a drum lift, the effect of over-running is so much more serious that additional precautions must be taken. A powerful mechanical brake may be so geared to the drum shaft as to come into operation if the drum travels too far in either direction. This brake must be sufficiently strong to stop the lift if the power is not cut off.

Good guides are essential. If a guide warps or comes loose from its fixing, all sorts of troubles ensue. If the counterweight should get clear of the guides, there is nothing to prevent the ascending car and descending counterweight from crashing into one another. Steel guides of round or special section seldom suffer in this way, and the extra cost is not great. Steel wire ropes, stretched taut from the top to the bottom of the well, are sometimes used as guides for the counterweight. This construction has the advantage that the counterweight fitted with eyes running on the ropes cannot easily get out of place. On the other hand, an extra clearance must be provided between the car and the counterweight to allow for lateral play.

Hand-rope control consists simply of a motor reversing switch, operated by the hand-rope, which passes through the car. An additional contact upon this reversing switch closes the circuit of a solenoid, which actuates a plunger attached to a rheostat, so cutting the starting resistance out of the armature circuit. To prevent this action taking place too quickly, a dashpot is employed to retard the motion of the plunger. The car-switch controller acts upon precisely the same principle, excepting that the hand-rope is replaced by a car-switch, the contacts of which are connected by a flexible cable so as to operate the motor-reversing switch by means of solenoids. Sometimes the car-switch is provided with additional contacts to provide a second or even a third speed through solenoid switches acting upon the field circuit of the motor. Usually, a field rheostat with solenoid-dashpot control is employed.

Electric lifts present the paradox that the size of the motor and gear is, to a large extent, independent of the speed of the lift. For instance, suppose a lift designed for 1-ton load at 100 ft. per min. requires a motor and a gear of a certain size, the same motor will run the same lift and raise the same load at 200 ft. per min., provided only that the motor winding is so altered that the motor runs at twice its former speed. There is, therefore, no occasion for any very great difference in the price of a lift upon account of speed.

The author then gave an account of the principles and some constructional features of push-button control, and incidentally dealt with some points in the design of door contacts.

He concluded his Paper by mentioning some of the matters to which attention must be given in the maintenance and inspection of lifts. The ropes must be kept under regular inspection, and any sign of undue wear or broken strands noted. Should any extension of a damaged place amounting to fraying occur, the ropes should be condemned at once. Any back-lash in the gear must be inquired into. It may be a loose key in the sheave or wormwheel which requires reseating, or, possibly, the teeth of the wormwheel are dangerously worn. The gear-case must be kept charged with oil, which must be changed as soon as it becomes thick or denaturalised. The best lubricant for the purpose is pure castor oil. The safety gear must be greased and inspected regularly and should be put to a practical test by allowing the car to drop upon it occasionally. All electrical contacts must be kept scrupulously clean and carefully adjusted, and a supply of spare contacts should always be available. Air dashpots require occasional adjustment to maintain correct acceleration. From time to time the leather should be treated with a little oil. The air escape vent must be kept clear of grit. When oil dashpots are used, great care must be taken to keep them clean and avoid troubles from the oil spraying out and damaging the insulation of the controller. Should it be necessary to dismantle the motor, the greatest care should be taken on re-assembling that the compound field windings are acting together. If by any chance they be connected up in opposition, the fault may not be observed at first, and so long as the shunt field has control the lift will continue to travel as before, but rather faster. Under these conditions, an increase in the load will cause the series current to rise rapidly; the motor will reverse, and running with a very weak field will precipitate the car at terrific speed upon the buffers.

ELECTRIC TRACTION NOTES

In a long and interesting Paper read on Tuesday before the Institution of Civil Engineers, Mr. F. W. Carter discussed the mechanical features of the electric locomotive. These locomotives were divided into two groups, those in which the axles are driven independently, and those in which they are coupled and driven collectively, the two groups corresponding generally with continuous-current and alternating-current systems of operations respectively. When the driving torque of the locomotive is impulsive, the resultant frequency of this torque may be in resonance with the natural frequency of vibration of some of the parts, and destructive vibrations may be set up. The polyphase locomotive from its constant speed characteristics is less likely to be affected from this cause than others. Electric locomotives have not always been designed with due regard to the question of stability of the rolling motion of the wheels, and some fail to run smoothly on this account. It is shown that a locomotive on a rigid wheel base, or divided into units each on a rigid wheel base, is in some circumstances unstable, and may develop a nosing tendency if run at high speed; guiding wheels elastically centred to align with the main wheels tend, however, to stabilise the motion.

Bow collectors are to be substituted for the trolley collectors of all cars of the Zurich tramway system. For some time past the cars on one route have been run with bow collectors, and, according to the *Neue Zürcher Zeitung*, the delays due to the trolley jumping the conductor and the repair and renewals costs have been so much reduced that the administration have decided to change over all the cars to bow collectors before the end of next March. The average life of the aluminium contact bars is given as 30,000 car-km., as compared with 12,000 for the trolley wheels. Besides this saving, the wear on the trolley wire is said to be considerably less, and new overhead construction for extensions less complicated.

The electrification of the Gotthard railway is shortly to be commenced in earnest, and, according to a Swiss contemporary, three million francs are to be expended on the scheme during the present year.

State Control of Electricity Supply in Switzerland.—On Dec. 28th the Council of the Canton of Aargau ratified an agreement whereby the distribution systems of the North-east Swiss Power Co. are purchased by the Canton. A State concern has been formed under the name of the Aargauische Elektricitätswerk which will distribute and sell power over the whole Canton. For the present the power will be purchased in bulk from the original power company.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Test Methods for Steam-Power Plants. By E. H. Tenney. 224 pp. 8¾ in. by 5 in. 85 figures. (London: Constable & Co., Ltd.) 10s. 6d. net; abroad, 11s.

THIS book treats from a chemical and engineering standpoint the various problems met with in central station operations. The titles of the six chapters will give a clear indication of its scope: The Purchase and Testing of Coal (88 pages); Investigation of the Economy of Combustion (19 pages); Treatment and Testing Water for Boiler Feed Purposes (86 pages); Evaporative Tests for Capacity and Efficiency (84 pages); Methods of Testing Prime Movers (88 pages); Testing of Power-Plant Lubricants (20 pages).

The importance of scientific purchase of fuel from a thermal basis has frequently been pointed out. At the same time too much importance may be attached to the calorific results obtained from a few grams of coal supposed to be representative of a cargo of, say, 2,000 tons; the error in correct sampling may be very considerable unless a suitable sampling and crushing machine is used, and none are described in the work before us. Besides, calorific value is not everything, as destruction of furnace brickwork is a factor to consider when selecting high calorific fuels. We do not think without other factors being considered it is in every case the best practice to purchase coal in the open market solely on a heat basis; it is better rather to use calorific values as a guide to the purchase of coal out of a selection which are found to be all suitable for the particular boiler plant under consideration.

Economy of combustion is briefly dealt with, but contains no new features. Feed-water treatment is discussed at some length from a water-softening point of view, and several types of American softeners are described, but no English examples are given. In the chapter on evaporative tests and efficiencies, flue gas analysis is dealt with at some length, but the only automatic CO_2 recorder described is the Simmance-Abady (of Detroit!); no mention is made of the improvements introduced by C. O. Mailloux, of New York.

In the testing of prime movers only steam engines and steam turbines are considered, and in the determination of water no mention is made of water meters, such as Lea recorders and other weir notch patterns, so useful for giving day-by-day results with fair accuracy.

The turbine data given on page 150 would appear to be somewhat out of date. In dealing with the measurement of ventilating air no reference is made to the various air-washing plants now so common; perhaps the author has realised the danger of many of them not becoming permanent unless greater care is exercised in their construction and maintenance.

Some space is devoted to steam meters, which have obtained but little footing in this country. The chapter on lubricants will appeal more to chemists than engineers; switch and transformer oils do not come within the scope indicated by the title, and are not mentioned. The book is a very useful one, and sets out American testing methods fairly and fully; the references to various authorities given at the end of each chapter will add to its value.

Handbook of Technical Instruction for Wireless Telegraphists. By J. C. Hawkhead. Second edition revised by H. M. Dowsett. 310 pp. 8¾ by 5½ in. 242 figures. (London: Wireless Press, Ltd.) 3s. 6d. net; abroad, 4s. 1d.

The constant demand for the first edition of this handbook has exhausted several reprints, and the publishers have now issued a second edition, revised and enlarged. Eighty-eight of the original diagrams have been redrawn, forty-seven new illustrations added, and the section of the book describing existing sets has been completely recast and brought up to date. The book is divided into three parts. Part I. deals with the general elementary theory of electricity and magnetism, specially treated to lead up to a study of wireless theory and practice. Part II. may be called an exposition of wireless theory—describing the production of electromagnetic waves and the arrangement of the receiving circuit. Part III. is devoted to wireless practice. It illustrates and describes existing sets of 1½ kw., ½ kw., and 5 kw. capacity, as well as various sizes and types of portable sets. It is concluded by a chapter on faults. Full descriptions of both old and new apparatus are given, as the thousands of ships now equipped have been fitted at different dates, and much old apparatus still exists on some of them.

The book is profusely illustrated and clearly written, and we have no doubt this new edition will meet with the same success as the first.

BURST OF A TURBINE-CASING: FOUR DAYS' COMPLETE SHUT-DOWN

THOSE of our readers who believe in the infallibility of German methods in all things electrical will be interested to learn the cause of a complete shut-down for over four days of the large water-power works at Saalach, which supply power to the Salzbourg-Berchtesgaden single-phase standard-gauge railway (a section of the Bavarian State Railways) and light and power to the town of Bad Reichenhall. The official explanation of the accident, published in the *Münchner Neueste Nachrichten* of Dec. 31st, reads as follows:—

During a trial run on the recently-electrified section Bad-Reichenhall-Berchtesgaden, a sudden overload tripped the automatic switch on the feeder supplying the railway. The one machine on this feeder was thus relieved of its entire load, and the automatic governor closed the stationary guide-blades of the turbine so suddenly that an excessive pressure was produced in the turbine-case as a result of the momentum of the incoming water. The turbine-cases are constructed in two parts, held together by bolts through the external flanges. Although high pressures due to this very cause have to be allowed for in the design, the casing did not withstand the strain, but opened along one flange. It is suggested that the strength of the bolts had been seriously reduced by too-frequent tightening up during erection.

The water, under full pressure, poured into the machine-room and flowed through the generator-pits into the cellar, passing, unfortunately, over the stator windings of every machine in the station. The windings soon became too wet to withstand the working pressure, and so the supply was completely cut off.

Besides the railway current, the supply of light and power to the health resort of Bad Reichenhall and the towns of Freilassing, Salzbourghofen, and Laufen was cut off, and numerous mills, factories, breweries, &c., were compelled to shut down. No supply whatever could be given during the holidays, and it was not until December 28th, at 6.30 p.m., *i.e.*, 101 hours after the accident, that one machine was compeltely dried out and put into service to supply light to Bad Reichenhall. On the following day the supply was again completely cut off between 12 and 1.30 p.m., but after this the greater part of the normal load was taken up again.

On account of the almost entire absence of other lighting means, the State railways authorities placed a number of cans of petroleum from their limited and now valuable stock at the disposal of the townships concerned. A small gas plant in Laufen was put into service, and in Freilassing the supply from a small plant belonging to the Föckerer Hotel was commandeered for the lighting of the railway station and the Post Office. As Bad Reichenhall is a very popular resort, the inconvenience of a complete stoppage over Christmas, with the present serious shortage of candles and petroleum in Germany, can well be imagined. The trial runs on the railway have been postponed indefinitely.

Institution Examinations.—The following Regulation has been approved by the Council of the Institution of Electrical Engineers:—

During the period of the war and for such further period thereafter as in the opinion of the Council it may be advisable, any candidate for admission as Associate Member who is engaged on naval or military service or employed (whole time) in an engineering capacity on munitions or other war work will be exempted from complying with the Examination Regulations; and any such service may at the discretion of the Council be accepted in part fulfilment of the conditions laid down by the Institution as regards experience, provided that in other respects the candidate satisfies the requirements as regards age and training.

Lighting Connections.—"'Lektrik' Lighting Connections," published by Mrssrs. A. P. Lundberg & Sons, is so useful and enjoys so wide a circulation that little more need be said of the fourth edition (25th thousand) that has just been published. It contains a new section on switching connections for motor-car lighting which will be useful, and embodies other improvements and corrections to the preceding edition published just over a year ago. A number of quotations from testimonials shows that the booklet is much appreciated by central-station engineers, as well as by wiring contractors and wiremen. For convenience of our readers we are keeping a small stock of copies, and orders (which should be accompanied by a remittance) will be dealt with by return of post. The price of the booklet is 7d. post free.

The Electrical Production of Nitrates.—Mr. E. Kilburn Scott will commence a course of six lectures on the "Electrical Production of Nitrates for Fertilisers and Explosives" at the University College, Gower Street, London, on Wednesday, Jan. 26th, at 5.30 p.m. The course is open to both members and non-members of the University, the fee for the six lectures being £1 11s. 6d. The remaining five lectures will be given on successive Wednesdays.

"ELECTRICAL ENGINEERING" PATENT RECORD

Specifications Published Jan. 6th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

24,169/14. **Demand Indicator.** B.T.-H. Co. (*G.E. Co., U.S.A.*) A thermal demand indicator comprising a thermostatic spring having one end secured to a metallic stud and the other end connected to an indicating member, a heating element within the stud, and a second thermostatic spring acting in the opposite direction upon the indicator so that it responds to the difference in temperature between the heated and unheated springs. (Five figures.)

7,607/15. **Cable Armouring.** A. Roselli. Armouring of lead-covered or other cables consisting of thin iron or steel ribbon helically wound in widely spaced coils with insulating ribbon wound in between so that the steel ribbons overlap and partially cover each other and a continuous protection is formed while the energy loss by hysteresis and eddy currents is diminished. (Two figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: Gray and Best [Searchlights] 616/15.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Geipel [Rubber-covered conductors] 24,235/14; Beaver and Claremont [Lead jointing sleeve] 6,093/15.

Heating and Cooking: Cable Accessories Co. and Reeves [Heating element] 5,889/15.

Ignition: Climie and Lees [Gas-engine ignition] 10,354/15.

Switchgear, Fuses, and Fittings: Maurice and Cash [Fittings] 3,261/15; Lundberg, Lundberg, and Pegg [Switches] 4,045/15; Ellison and Anderson [Attachment of conduits to switches] 5,727/15; Sturge [Combined switch-and-wall plug] 5,879/15; John [Replaceable fuses] 13,051/14.

Telephony and Telegraphy: Armstrong [Receiving continuous waves] 24,231/14; Wechsler [Transmission] 24,746/14.

Traction: Renault [Car lighting] 24,121/14; Midgley and Vandervell [Engine-starters] 2,619/15.

Miscellaneous: Bousson [Vapour electric lamps] 24,502/14; Cole [Signalling] 647/15; Sterling Telephone & Electric Co. and Ward-Miller [Terminals] 1,090/15; Curtis and Igranic Electric Co. [Control apparatus] 2,014/15.

The following Specification is open to Inspection at the Patent Office before Acceptance, but is not yet published for sale.

Electrometallurgy: Aktiebolaget Elektriska Ugnar [Electric furnaces] 17,022/15.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

999/02. **Tramway Points.** E. de Pass (*Cheatham Electric Safety Device Co., U.S.A.*). A system of solenoid-operated tramway track and overhead line points controlled by the passage of the car with its controller on or off.

1,061/02. **Telegraphy.** F. G. Creed. A telegraph system in which the message is received as a perforated strip.

1,359/02. **Ignition.** F. R. Simms. Primary magneto ignition for gas engines, &c., in which the oscillating part of the magneto is deflected by a cam and returned by springs which at same time actuate the break contact in the sparking plug.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: Siemens Bros. Dyn. Wks. (*Siemens-Schuckertwerke*) [A.C. commutator machines] 21,542/09.

Incandescent Lamps: W. D. Coolidge [Squirted filaments] 282/09.

Switchgear, Fuses, and Fittings: C. E. Hunter and W. H. Warren [Push switches] 20,278/04; W. Roberts [Switch fuses] 21,091/06.

Miscellaneous: A. P. Jones ("*Long Arm" System Co., U.S.A.*) [Electrically-worked bulkhead doors] 20,351/04; E. Mitchell [Advertising device] 20,882/07; R. Scherl [Gyroscopic control of vehicles] 21,843/08.

ELECTRICAL MACHINERY FOR SHIPS

At a meeting of the Liverpool Engineering Society last month Mr. C. E. Jones dealt generally with the above subject, mainly in connection with the merchant service rather than the Navy. Dealing first with design, the author pointed out that the working of a vessel when in a sea-way requires that all large machinery be mounted on a strong bedplate and stiff seating. The condition of running for long periods must be met by liberal proportion in design, and owing to facilities for lifting being frequently limited, heavy parts should be split up. Corrosion due to salt water has also to be guarded against by choosing suitable materials, and by enclosing, or varnishing, or painting with suitable compositions. Sound mechanical construction of brush gear was also particularly insisted upon.

For determining the capacity for small installations up to 100 kw. the author recommended that the power required for all the motors on full load, lighting, heating, wireless, and cooking, should be added, and a further 10 to 15 per cent. allowed for future additions; but in the case of larger main generating plants a more accurate estimate should be made from the probable daily load curve. It is usual to instal three or four sets, the actual number invariably being one in excess of that required for the peak load. Turbo-generating plant is now being adopted instead of reciprocating engines on new ships, even for such small sizes as 100 kw. and upwards. On the subject of breakdowns of generating plant, the author mentioned particularly cases that had come within his experience of the breaking of armature shafts due to bad alignment with the use of rigid couplings.

The following list was given of a few typical generating plants :—

Aquitania.—4–400 kw. Westinghouse turbo-generators, 1,500 r.p.m., 220 volts, 3-wire.

Mauretania and *Lusitania.*—4–375 kw. Parsons turbo-generators, 1,200 r.p.m., 110 volts.

Britannic and *Olympic.*—4–400 kw. 3-crank, Allen compound forced lubr. enclosed engines at 325 r.p.m., 100 volts.

Alsatian and *Calgarian.*—3–250 kw. Westinghouse turbo-generators, 3,000 r.p.m., 220 volts, 3 wire.

Missanabie and *Metagama.*—3–100 kw. Greenwood & Batley-Siemens geared turbo-generators, 13,000–1,000 r.p.m., 100 volts.

Camito and *Coronada.*—3–90 kw. Allen-Campbell & Isherwood 2-crank compound enclosed engines at 450 r.p.m., 100 volts.

Elsby and *Elele.*—2–20 kw. Matthew Paul-Campbell & Isherwood, single cylinder enclosed engines at 600 r.p.m., 100 volts.

With regard to voltages, 100–110 are now common, and 200-220, the latter usually between outers on the 3-wire system. On war vessels 220 volts is used very successfully, and it is said that 440 volts is being seriously considered. The subject of 3-wire generators was entered into at considerable length in the Paper. On ships it is quite possible to arrange the load on the two sides of a 3-wire system, that the difference does not exceed 15 to 20 per cent. This makes it possible to adopt a generator of the 3-wire type, having, in addition to the armature of an ordinary machine, two or more slip-rings connected to points of the winding, according to the type of winding. Connections are taken from the slip-rings to a choking coil, the central point of which furnishes the point to which is connected the middle wire of the system. Should the out-of-balance load exceed that which the machine will deal with satisfactorily, a mid-wire booster may be installed. Some special points in connection with bearings were considered. The pitch and rolling motion affects oiling systems depending on gravity for their action. Oil wells should not spill when the bearings are sloped 35 degrees. Lateral thrust of revolving parts due to motion and list which the vessel may assume must be provided for.

The Paper was concluded with a brief description of some particular types of deck machinery, including winches and lifeboat hoists, deck cranes, and electric hoists.

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,477.

It is proposed to erect a repair shop for a calico-printing works. The equipment will consist of three 2 ft. 6 in. centre lathes, a drilling-machine, a small plane, and possibly one or two other small machine tools. What are the points to be considered in deciding whether individual electric drive or a common drive from one motor will be preferable for these tools? (Answers are not to exceed 500 words in length.)

(*Replies must be received not later than first post, Thursday, Jan. 20th.*)

ANSWERS TO No. 1,475.

In a small electric bell installation there are pushes in three rooms and a bell with a three-way indicator close to it; the wiring is metallic circuit without common return. It is desired to alter the installation by the addition of two more bells next to the existing one, and the use of a group of three pushes instead of a single push in each room, connected so that a different bell rings for each room, and the number shown on the indicator gives the number of the push used. How can this be done with the minimum alteration in wiring?

The first award (10s.) is given to "E. B. P." for the following reply:—

The accompanying diagram of connections gives what I consider to be a simple method of making the necessary additions. Existing wiring and apparatus are shown by thick lines, wiring to be discarded by plain dotted lines, and new

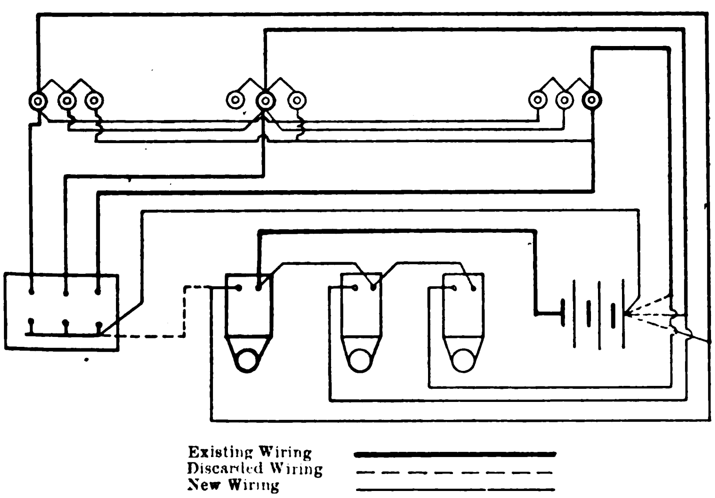


FIG. 1.

wiring and apparatus by thin lines. The additions to the existing wiring are, as far as possible, made by looping in, this method being not only preferable to having a large number of tee joints about the installation, but, in addition, involving much less interference with the present wiring. The diagram would have looked simpler had looping in not been adopted, but this simplicity would have been more apparent than real.

It may be noted that if the battery is at present connected between the indicator and the bell, even less alteration to the existing wiring will be required.

The second award (5s.) is made to "H. C. R." for the following reply:—

In the scheme proposed all existing lines, marked "X" in the diagram, are made use of, and with two exceptions the

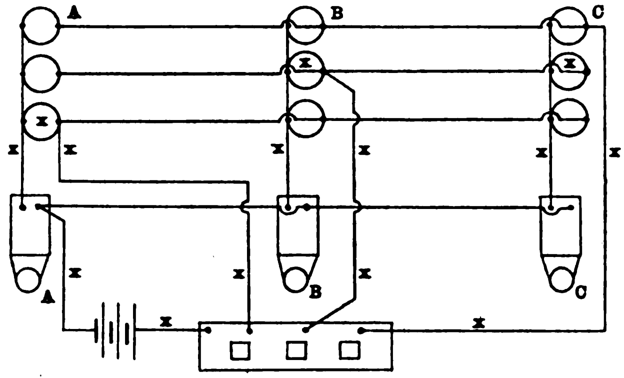


FIG. 2.

connections are the same. These exceptions are the lines from rooms *B* and *C*, which go to bells *B* and *C* respectively instead of bell *A* as formerly.

ANSWER TO CORRESPONDENT

H. T.—If you propose to take current simultaneously from both sides of your 3-wire 'bus bars and want to be able to observe the current at any time with your one ampere-meter, you will have to cut it in circuit with a 2-pole throw-over switch. The voltmeter could have a 2-way single-pole switch with off position so that it could be momentarily connected between either the 0 and − or the 0 and + 'bus bars. But we cannot see why on earth you want to do all this with circuits fed by 6 dry cells.

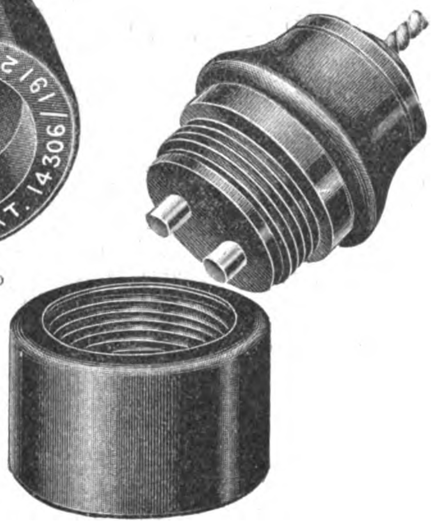
The Electrical Engineer's Diary.—The 1916 edition of the Electrical Engineer's Diary, published by Messrs. S. Davis & Co., St. Swithin's Lane, E.C., which is edited by Mr. J. H. Johnson, contains a number of new and useful features, in addition to which the standard features have been brought up to date. The publication is now something considerably more than a diary; it is a handbook on many applications of electricity, and contains a mass of technical and general information not, to our knowledge, collected elsewhere in so convenient a form. All the information so given has been specially compiled. Important additions are a section dealing with industrial lighting, and another on electric cooking, the latter being the work of Mr. R. S. Downe, manager of the Brompton & Kensington Accessories Co., Ltd. The list of streets in which electricity mains are laid has been extended so as to include a number of outlying districts. The diary is now published in two forms, one giving the diary and technical information tables, &c., and the other leaving out the actual diary pages.

Electrically-fixed Nitrates for German Explosives.—Herr Alfred Lohmann, Chairman of the Chamber of Commerce of Bremen, stated at a meeting on Dec. 28th that the numerous new electric nitrate works in Germany had succeeded in producing not only all the saltpetre required for the production of explosives, but would be able to supply during the coming spring all the artificial fertilisers required for agricultural purposes. As Germany previously imported over half of the total Chilean production of natural nitrates, this is a remarkable achievement for the German electrical industry if it is actually the truth. Herr Lohmann even suggested that Germany would shortly be able to export artificial nitrates, but in view of the comparatively high cost of electric power in Germany the price would exclude any competition with Chilean nitrate or even with the Norwegian products.

A NEW INSULATED LAMP-HOLDER

A SAMPLE of the lamp-holder illustrated below has been sent us by G. St. John Day (Patents), Ltd. (Bank Mill, Morton Street, Oldham). It is simple and well-made, and possesses the feature that it is all of insulating material with the exception of the contact-making plungers and their ter-

LAMP-HOLDER SCREWED TOGETHER.



LAMP-HOLDER WITH RING REMOVED.

minals. The design of the holder and pins is such that the wiring is simpler and quicker to carry out than with the ordinary lamp-holder, and the risk of unscrewing the holder and short-circuiting when removing and replacing the lamp-shade—a risk always present in the usual forms of lamp-holder—is quite avoided.

A USEFUL GAUGE FOR CONDUIT WIRING

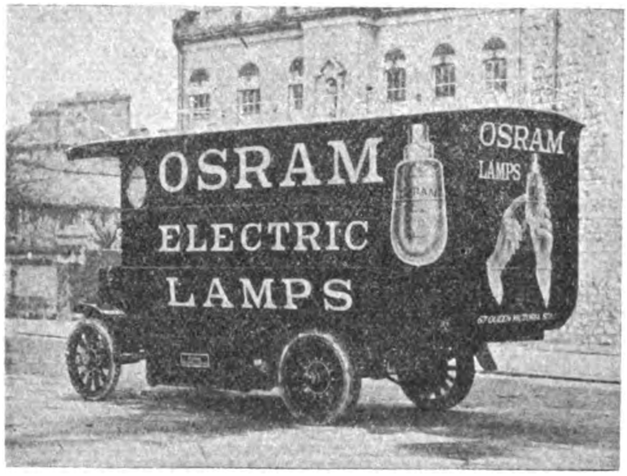
SIMPLEX CONDUITS, LTD. (Garrison Lane, Birmingham), have sent us a useful pocket gauge for ascertaining the number of wires which can be placed in a conduit of any size. It consists of four brass discs with holes accurately representing the bore and sizes of heavy-gauge conduits from ½ in. to 2 in., and a book of cards upon each page of which is printed a number of circles in contact. The 12 pages of the book cover 12 sizes of cable from 1/18 to 37/14, and by placing the disc representing the size of the conduit upon any page, it is possible to see at once the number of cables of the size in question which the conduit will carry comfortably. The discs and book of cards are carried in a neat and convenient leather pocket-case.

Fatal Shocks from a Motor-car.—The inquest on the two men who were killed at Eastbourne in the accident reported in our issue of Dec. 30th was resumed last week, when Mr. A. P. Trotter, Electrical Adviser to the Board of Trade, was present. Mr. J. K. Brydges, the Borough Electrical Engineer, stated that switch and transformer pillars were now placed above ground because many accidents had happened to employees in the past when the pillars used to be below ground. The suggestion was made that the car was magnetically drawn towards the pillar, but Mr. Brydges and Mr. Trotter, of course, dismissed this as impossible. The jury returned a verdict of death from misadventure.

London Street Lighting.—In the House of Commons on Wednesday last week Mr. George Terrell drew attention to the waste of electrical energy in connection with street lighting in London by blackening over the lamps as a protection against hostile aircraft raids, and asked the President of the Local Government Board if steps could be taken to reduce the candle-power. Mr. Hayes Fisher, who replied, said that in a large proportion of the public lamps the candle-power had been reduced, whilst to reduce the candle-power on others would involve a greater initial capital expenditure than the saving would warrant. To use low-candle-power lamps in unblackened globes would not fulfil the main object of the present regulations.

THE "OSRAM" ELECTRIC VEHICLE

WE give below an illustration of the "Osram" electric vehicle which has lately been added to the fleet of express delivery motors employed by the G.E.C. for the delivery of "Osram" lamps to all parts of the United Kingdom. This van is handsomely finished in dark blue and presents an imposing appearance. The gross weight is 2 tons 12 cwt., of which the Edison accumulator accounts for 16 cwt. The wheelbase is 10 ft. 8 ins. A load of 2 tons can be carried, the accommodation being sufficient for between 11,000 and 12,000 standard "Osrams."



The average speed on the flat is 10 m.p.h., and between 40 and 45 miles can be covered on one charge. Recharging is effected by a dynamo at the Osram-Robertson Lamp Works, Hammersmith. In addition to rheostatic braking, a system of band brakes is provided.

The adoption of this kind of delivery van is evidence that the Osram-Robertson Lamp Works is as progressive in other matters as it is in the manufacture of lamps.

CATALOGUES, PAMPHLETS, &c., RECEIVED

ELECTRIC WATER-HEATER.—Messrs. Ferranti, Ltd. (Central House, Kingsway, W.C.), issue an interesting leaflet describing their domestic electric water-heaters, which are designed to operate either alone or in conjunction with ordinary kitchen boilers. The heating element, which is about 6 ins. in diameter by 18 ins. long, is mounted on a circulating pipe connected to the top and bottom of a cistern. These heaters are made in five sizes, for cistern capacities of 23 to 34 gallons, and consuming 350 to 700 watts. They will heat 1½ to 3 gallons of water through 60° F. every hour. The makers recommend that they should be left in continuous operation.

INCANDESCENT LAMPS.—From the Rugby Lamp Co., Ltd. (Rugby), comes a list of metal and carbon filament lamps for both lighting and radiator purposes. These lamps are supplied to the Admiralty, War Office, and other Government Departments.

ELECTRIC HOT-PAD.—The Hotpoint Electric Heating Co. (38 Poland Street, Oxford Street, W.) has introduced a new type of flexible metal hot-pad known as "El Comfo." It is constructed of nickel-plated metal in such a way that it can be bound round an arm or leg, or used as a dry heat application on any part of the body. The heat can be maintained within 100 to 200° F., and cannot exceed the latter, as a thermostatic cut-out is arranged inside the appliance. Another type is made of aluminium, but is not flexible.

CALENDARS, &c.

The leather-covered 6 in. by 3½ in. diary from Simplex Conduits, Ltd. (Garrison Lane, Birmingham), is of exceptionally good quality, and one essentially for engineers. There is an absence of general tables of the sort that enable one to calculate the date upon which Easter will fall ever so many years ahead, changes of the moon, and incorrect postal charges, and in their place we have tables really useful to electrical engineers, to say nothing of a model specification for a screwed conduit electric lighting installation.

From Messrs. Alexander Duckham & Co., Ltd., Millwall, London, E., manufacturers of compounds and oils, we have to acknowledge a well-made Treasury Note case. The size of it enables the notes to be laid full length.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Leicester.—An expenditure of £14,000 to meet the immediate requirements of the electricity undertaking is necessary, and an application is to be made to the Local Government Board for the loan.

Manchester.—The Electricity Committee requires sub-station converters, traction boosters, and high and low pressure steam and water piping. Jan. 18th.

Stockton-on-Tees.—A new rotary converter plant is required for the Corporation electricity undertaking.

Miscellaneous

Australia.—The Melbourne, Brunswick & Coburg Tramways Trust requires a supply of wheels and axles. Tenders by January 19th. Tenders are also invited for six radial-type trucks by February 18th. Further particulars at 73 Basinghall Street, London, E.C. The above information is only of value to firms able to communicate with agents in Australia.

London: *H.M. Office of Works.*—The Commissioners of H.M. Office of Works and Public Buildings invite tenders from manufacturers only for white earthenware electric lamp shades. Secretary, H.M. Office of Works. Jan. 17th.

Pembroke (Ireland).—The Council require a 12 months' supply of electrical stores. Chairman of Council. Feb. 7th.

South Africa.—The South African Railway Headquarters, Johannesburg, require tenders by January 17th for 19,266 drawn wire lamps of various voltages and 55,700 similar lamps for train lighting purposes, 24 volts, 8 to 10 candle-power. Further particulars at 73 Basinghall Street, E.C. The above is only of value to firms who can cable agents.

South Shields.—The Electricity Committee recommends application being made to the Local Government Board for a loan of £1,850 in order to hire out electric motor vehicles and to purchase a motor waggon for the undertaking. There was some opposition in the Council when the scheme was discussed, but eventually the proposal was agreed to.

LOCAL NOTES

Aberystwyth: *Supply Interruption.*—A fire, starting from an at present unknown cause, occurred at the electricity works on Monday morning. It apparently started in the cable trench betwen the dynamos and switchboard, and, spreading to the board, destroyed the wires on the centre (neutral) panel, as well as the ends of the outgoing feeders and the battery regulating cables. On arriving at the works Mr. E. P. Perkins, the resident engineer and manager, was able with one man to get through the smoke and put out the fire with the sand which was in readiness. The damage will amount to several hundred pounds. Supply was resumed yesterday (Wednesday).

London: *Hackney: High-tension Scheme.*—The Electricity Committee report that the 3,000-kw. turbo-alternator installed by Messrs. Willans & Robinson has satisfactorily passed its official tests. A grid type resistance, having a capacity of 200 amperes for three minutes, is to be placed in series with the earth connection of the extra high-tension three-phase system, at present connected direct to earth, in order to minimise the effect of severe shock to the system consequent upon a fault.

St. Annes-on-Sea: *Coal Troubles.*—Mr. J. H. Clothier, Borough Electrical Engineer, reports further decreases in the number of units sold for lighting and traction purposes. This, however, is compensated for by heavy increases in industrial demands. As regards the coal supply, this is causing great anxiety. The existing contract expires at the end of January, and it has not been possible at present to secure a renewal or even offers for any quantity with the exception of a 100-ton lot.

Stockton-on-Tees: *Further Bulk Supply.*—Mr. J. J. Smith, the Borough Electrical Engineer, has recommended that an increased supply of electricity should be taken from the Cleveland & Durham Electric Power Co., Ltd. In this way it is anticipated that considerable saving will be obtained as against installing new steam generating plant and extending the existing buildings.

Wolverhampton: *Death from Electric Shock.*—An employee at the Efandem Electrical Co.'s works, Wolverhampton, met his death by electric shock on Friday last under curious circumstances. During a gale a shed was blown down, exposing a live wire and leaving it hanging near a door. In approaching the door deceased apparently touched the wire and received a fatal shock. At the inquest the electrician at the works stated that after the gale he had all the fuses withdrawn in order to render the plant safe, and his suggestion was that somebody must have replaced the fuse in connection with this wire. The jury eventually returned a verdict of accidental death.

APPOINTMENTS AND PERSONAL NOTES

The salary of Mr. C. N. Hefford, Manager of the Leeds Corporation electricity undertaking, is to be increased from £600 to £800 per annum. There was some opposition to the proposal when it came before the Corporation, but the Chairman of the Electricity Committee pointed out that the salary now being paid to Mr. Hefford, who had completely justified his appointment since Mr. Dickenson went to Liverpool, is considerably less than that paid to engineers in charge of similarly large undertakings.

Mr. A. E. McKenzie, Chief Assistant Engineer to the Manchester Corporation, has been promoted to the post of Deputy Chief Engineer at a salary of £700, rising to £800 per annum.

The Government of Malta requires an assistant electrical engineer, salary £130 to £150 per annum, engagement for three years. Applications to Messrs. Preece, Cardew, Snell & Rider, 8 Queen Anne's Gate, London, S.W.

The Abertillery Urban District Council requires a practical electrician, accustomed to the three-wire direct-current system, for the Aberbeeg Electricity Works. Salary £2 10s. per week. Applications to the Clerk.

Mr. J. E. M. Stewart, Chief Assistant in the Leicester Electricity Department, has resigned on account of ill-health. A successor is to be advertised for at a salary of £300 per annum.

Mr. H. C. Babb has been appointed manager and engineer of the electricity works at Bo'ness. He has for some time been chief technical assistant at Hawick.

An electrical wireman is wanted for a Government-controlled factory. (See an advertisement on another page.)

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £113 to £115 (last week, £110 to £112).

Greenly & Denison.—We are informed that Mr. A. J. Greenly and Mr. T. Denison have taken over the Baldwin & Wills Works, St. Albans Road, Watford, and have commenced business as manufacturing electrical and mechanical engineers under the style of Greenly & Denison. The offices of the partnership are at 37 & 38 Strand, W.C., and, in addition to the munition work now being carried out, quotations for small turning and boring, screw-cutting, planing, die-casting, and wood-working of every description can be given. The Greenly Advertising Service will be carried on by Mr. A. J. Greenly as hitherto.

The Benjamin Electric Horn.—The Benjamin Electric, Ltd. (1A Rosebery Avenue, London, E.C.), is making a special New Year's offer to the trade of their 33s. 3d. electric motor horns for 11s. 3d. net.

A Cryselco Social Evening.—On Dec. 31st Cryselco, Ltd., entertained their employees in the usual way, and a very pleasant time was spent. The works closed early, and at six o'clock the staff and employees met together again, a company of 300 sitting down to a high tea. An entertainment followed, and later on dancing and games were indulged in. All the arrangements were carried out by the staff under the direction of Mr. A. R. Powell and Mr. A. R. Harrisson, and the presence of a large number of khaki-clad friends of the girl employees "added the final touch to perfect enjoyment."

TRADES DIRECTORY OF
ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
E. S. Co., Ltd., The Light House, 233, Tottenham Court Rd., W.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Naylor Battery Co., 1, Lammermoor Rd., Balham, S.W.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

COMMUTATOR CEMENT.
Godfrey & Co., 54, Lower Thames St., E.C.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

FLEXIBLE METALLIC TUBING.
United Flexible Metallic Tubing Co., Ltd., 112, Queen Vict. St., E.C.

HEATING AND COOKING APPARATUS.
Belling & Co., Derby Rd., Edmonton, N.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electrical Trading Co., Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Record Electrical Co., Ltd., Caxton House, Westminster. S.W.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Blume (Chas. H.), The White Building, Sheffield.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., Macks Rd., Bermondsey, S.E.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Ltd., 19 & 70, Lombard St., E.C.

LADDERS.
Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.

LAMPS (Incandescent)—*contd.*
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London & Rugby Engineering Co.. Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

MOTORS AND DYNAMOS.
British Thomson-Houston Co.. Ltd., Rugby.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Langdon-Davies Motor Co., 110, Cannon St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons. Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

RUBBER GLOVES.
Ingram (J. G.) & Son, Hackney Wick, N.E.
Moseley (D.) & Sons, Ltd., Ardwick, Manchester.

STEAM ENGINES AND TURBINES.
Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
United States Metallic Packing Co., Ltd., Bradford.

SWITCHGEAR.
British Thomson-Houston Co., Ltd., Rugby.
Dorman & Smith, Ltd., Ordsal Electrical Works, Salford.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Electric Control, Ltd., 177, Reid St., Bridgeton, Glasgow.
Ellison (George), Warstone Lane, Birmingham.
Ferranti Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Igranic Electric Co., Ltd., 147, Queen Victoria St., E.C.
Record Eleetrical Co., Ltd., Caxton House, Westminster, S.W.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.

TECHNICAL BOOKS.
Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
Constable (Archibald) & Co., Ltd., 10, Orange St., Haymarket, W.
Crosby Lockwood & Son, 7, Stationers' Hall Court, E.C.
Macmillan & Co., Ltd., St. Martin's Street, W.C.

TELEPHONES.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Graham (Alfred) & Co., St. Andrew's Works, Crofton Park, S.E.
Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

ELECTRICAL ENGINEERING

With which is Incorporated

THE ELECTRICAL ENGINEER

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SUMMARY

Professor Miles Walker's Paper on the performance of dynamo-electric machinery was read and discussed at the Institution of Electrical Engineers in London last Thursday (p. 22).

Mr. George Tucker, Publisher and Chief Proprietor of *The Electrician*, died last Saturday (p. 22).

A Paper on "The Principles and Systems of Electric Motor Control" was read on December 10th before the American Institute of Electrical Engineers, by Mr. C. D. Knight, who discussed the various forms of magnetic control in vogue to-day for A.C. and D.C. motors (p. 23).

Among the subjects of specifications published by the Patent Office last Thursday were treatment of rubber insulation, telegraphy, searchlight control, and switches.—A patent for flexible tramcar trucks expires this week after a full life of fourteen years (p. 24).

The improved lighting units which are now on the market for industrial lighting purposes are rendering unnecessary in many instances the local lighting of particular machines or work places. We report a discussion at the Illuminating Engineering Society in which this and some other points are brought out (p. 24).

The difficulties of tendering for electrical schemes in China are pointed out (p. 24).

We describe an interesting application of the vacuum system of ash removal in a small power station. The absence of working parts renders this system economical to work as well as cheap to instal (p. 25).

Our "Questions and Answers" page this week deals with troubles on a D.C. generator caused by the reversal of its direction of rotation (p. 26).

We review a book on "Electrical Engineering" and one on generating plant problems (p. 26).

The organisation and work of the electrical department of the U.S.A. Bureau of Standards at Washington is described (p. 27).

High-tension cable is required at Luton; ash-handling plant at Manchester; electric lamps at Middlesbrough and Bermondsey; and mains and services at Halifax (p. 27).

Owing to the difficulty of obtaining new generating plant, the Dewsbury Corporation has been compelled to buy a second-hand set.—It is proposed that the tests for pressure which the London County Council carries out upon the mains of the various supply authorities in London should cease during the war.—The scheme for training women electricians at Liverpool is progressing (p. 28).

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

(*To-day*) *Thurs., Jan. 20th*: Shooting for Sections III. and IV.

Fri., Jan. 21st: Sections III. and IV., technical. Sections I. and II., squad. Signalling section and recruits.

Mon., Jan. 24th: Sections I. and II., technical. Sections III. and IV., lashings and trestle bridging. Signalling class and recruits.

Tues., Jan. 25th: School of arms, 6 to 7 p.m.

Thurs., Jan. 27th: Shooting for Sections I. and II. and Signalling Class.

Fri., Jan. 28th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Jan. 29th: Uniform parade, 2.45 p.m.

Sections for technical parade at Headquarters, London Electrical Engineers, 46 Regency Street, S.W.

Sections for shooting parade at miniature ranges.

Unless otherwise ordered, all parades at Chester House.

(*For "Arrangements for the Week" see p. 22.*)

THE PERFORMANCE OF DYNAMO-ELECTRIC MACHINERY

THE Paper on the predetermination of the performance of dynamo-electric machinery, summarised in our last issue, was read by Professor Miles Walker at the Institution of Electrical Engineers in London last Thursday. The discussion on the Paper was opened by Dr. S. P. Thompson, who referred to the limitations in the predetermination of the performance of a machine imposed by variations in the quality of materials; it was no use making laborious calculations to obtain an accuracy of one-tenth of one per cent. in the performance of a certain iron, for instance, when its quality could not be depended on within two or three per cent. Much design that had been done in the past had been based on empirical formulæ obtained from experiment and without any apparent theoretical basis. Some of these formulæ had since been investigated and proved to have a true scientific foundation. Such was the case with Esson's famous formula, first announced at a meeting of the Institution some thirty years ago; this stated that the specific output of a machine varies as the armature volume, or kw. ÷ r.p.m. = K.d²l.

This formula, which was obtained from tests on machines, could now be proved from theory, and, moreover, the value of the constant could be stated exactly in terms of magnetic loading, electric loading, and the degree of space utilisation, *i.e.*, the ratio of pole arc to pole pitch. Referring to the author's method of calculating e.m.f. wave forms, Dr. Thompson said he did not think it was generally known why a distributed winding gave an approximate sine wave, whatever the shape of the field form, and he proceeded to show by an example on the blackboard how the e.m.f. wave form of an individual conductor always consists of a fundamental sine curve and a number of harmonics, and how these harmonics produced in various conductors cancel one another, leaving only an approximately sinusoidal fundamental. The one point in the paper he would criticise was the use of a universal calculation form for all types of machines. There were characteristics peculiar to each type of machine which ought to be prominently shown on the design form, and this was not possible on a universal sheet.

Mr. A. R. Everest agreed with the last speaker as to the doubtful advantages of the author's proposed common calculation sheet. He also drew general attention to the confusion of thought caused by the use of different symbols by different authorities. He did not think it was a good thing to combine several constants in one as the author had done in his e.m.f. formula; it prevents a designer from keeping clearly before himself the allowance he is making for various factors.

Mr. H. Burge doubted some of the advantages mentioned by Professor Walker as obtaining with his proposed formula for e.m.f. Seeing that each particular frame has a definite number of poles, he thought that flux per pole is as convenient to consider as total loading.

Mr. C. C. Hawkins was inclined to agree with the author as to the desirability of an "almost" universal calculation form; small modifications should be made to suit different types of machines. In calculating the field form of a rotor with highly saturated teeth, he thought the saturation of the rotor itself should also be taken into account, as it is liable to have an appreciable effect on the result.

Dr. S. P. Smith showed by example on the blackboard how the e.m.f. formula in the form given by the author could be obtained directly from first principles by using the expression for force on a conductor (B.I.L. 10^{-1} dynes) and multiplying it by speed. He thought it was preferable to use mean density rather than maximum.

Owing to lack of time, Professor Walker reserved his reply for a written communication.

Arrangements for the Week.—(*To-day*) *Thursday, Jan. 20th.*—Institution of Electrical Engineers: "The Principles of Modern Printing Telegraphy," by H. H. Harrison.

B.E.A.M.A. Informal dinner and discussion, Connaught Rooms, Kingsway. 7 p.m.

Tuesday, Jan. 25th.—Manchester Section I.E.E. Engineers' Club, Albert Square. 7.30 p.m.

Institution of Civil Engineers. Further discussion on "The Electric Locomotive," by F. W. Carter.

Wednesday, Jan. 26th.—Liverpool Engineering Society. At University. "Recent Developments in Telephony," by G. C. Marris.

Saturday, Jan. 29th.—Association of Mining Electrical Engineers. Notts and Derbyshire Branch. At University College, Nottingham. "Unusual Breakdowns in Colliery Electrical Plant," by R. Devine. 3.30 p.m.

Lighting Connections.—In the notice of Messrs. A. P. Lundberg & Sons, "Lektric Lighting Connections," on page 15 of our last issue, we inadvertently gave the 4th edition as 25,000 copies. This, as a matter of fact, should have been 35,000 copies. We might add that the forthcoming French edition will bring the total up to 37,000.

OBITUARY

GEORGE TUCKER.

WE regret to announce the death, on Saturday last, of George N. G. Tucker, publisher, manager, and chief proprietor of *The Electrician*. Mr. Tucker, who was sixty-four years old, had been associated with *The Electrician* since 1878, when the paper was re-started (it had been founded in 1861, but ceased publication after about four years' run. When it was resumed in 1878, *The Electrician* was printed and published at the offices of *The Observer*, and Mr. Tucker was one of the compositors in the printing department. In 1883 the paper started its own printing office, and Mr. Tucker was appointed overseer, Mr. C. H. W. Biggs, who was then Editor, exercising general control over the management as well. On Mr. Biggs leaving in 1887, Mr. Tucker became publisher and manager. He continued in this position during the editorships of the late Mr. W. H. Snell, Mr. A. P. Trotter, Mr. W. G. Bond, the late Mr. Tremlett Carter, and Mr. F. C. Raphael, all of whom successively occupied the editorial chair, but were not concerned in the business management. In 1906 the Proprietors of *The Electrician*—Sir John Dennison-Pender, Mr. Louis Floersheim, and Mr. Kenneth Anderson—decided to sell the paper and the fairly lucrative publishing and general printing business attached to it, which had been developed largely by Mr. Tucker's individual efforts, and they accepted an offer by Mr. Tucker by which all the shares were transferred to him and his nominees. Mr. W. R. Cooper succeeded Mr. Raphael as Editor, and the paper has been continued more or less on the same lines. Mr. Tucker's strong personality, reminding one sometimes of Thackeray's publishers in "Pendennis," and his marked business ability will be remembered by all who came in contact with him. He was a hard and energetic worker, and never spared himself, and even during his last illness, which lasted for some months, he continued to take an active part in the management of his business. We offer our sincerest sympathy to our contemporary for the loss it has suffered.

The Institution and Enemy Members.—The question of whether any action should be taken by the Council of the Institution of Electrical Engineers with regard to alien enemy members has been further discussed. On p. 492 of our issue for December 9th and p. 506 of our issue for December 23rd the position as it then stood was discussed and the Institution's attitude explained. The Council has now passed the following resolution:—

The Council are of opinion that Clause 41 of the Articles of Association provides sufficient means for the expulsion of undesirable persons (whether alien enemies or not) from the Institution, consistently with making the thorough investigation of the circumstances of each case which is essential in order to avoid the risk of doing grave injustice to individuals.

The Council, however, have under consideration the question whether the Institution should obtain further powers for the expulsion of alien enemies. Clause 41 puts on "ten or more corporate members" the responsibility of taking the initial step, and would be a cumbersome method of procedure never intended to be applied to anything else than individual cases of misdemeanour, &c. The Council should certainly have the Articles amended, without further delay than is necessary for the calling of the formal meetings, so that alien enemies should no longer remain members of our Institution.

The British Thomson-Houston Co.—In the November 21st issue of the *Sunday Chronicle* an article appeared under the name of "John Briton" in which much play was made with the name of the Tungsten Lamp Association, it being suggested that it is German-controlled. The name of the British Thomson-Houston Co. was also somewhat freely used, with the result that an action for libel was started against our Manchester lay contemporary by the B.T.-H. Co. The sequel is to be found in the January 16th issue of the *Sunday Chronicle*, when any suggestion that the B.T.-H. Co. is German owned or controlled is unreservedly withdrawn.

Trade Development after the War.—According to the *Times*, an important report from the Advisory Committee of the Board of Trade is in the press, and may be expected shortly. It is understood that Government subsidies for certain industries are advocated and protection by tariff also approved by overwhelming majorities. The trades concerned include electrical apparatus. It is also said that the Committee has dealt with copyright, trade marks, and patents, and that a section of the report is devoted to the great need for scientific training and research. The Advisory Committee includes representatives of the Board of Trade, Colonial Office, the Colonies, and a large number of commercial men in this country.

ELECTRIC MOTOR CONTROL

AT a meeting of the American Institute of Electrical Engineers on December 10th, Mr. C. D. Knight read a Paper on "The Principles and Systems of Electric Motor Control," which is published in the Institute *Proceedings*. After describing several types of resistance used for control purposes, the author explained the various forms of magnetic control in vogue to-day for both D.C. and A.C. motors. The contactor, or magnet-operated switch, is the basic device of nearly all automatic motor-control systems. The essential parts of such a switch are as follows:—(1) The contacts: the best practice is to use solid copper contacts by which the current is both carried and broken; (2) the blow-out: the blow-out coil is in series with the circuit through the main contacts which are between the poles of the blow-out; (3) the magnet; (4) the frame; (5) pivot bearings.

After describing various types of industrial contactor, including D.C. shunt contactors, series contactors, and A.C. contactors, the author passed on to a discussion of various methods of automatic control. For D.C. motors there are several methods in use as follows:—

Counter Electromotive Force.—This method of control is more satisfactory for use with shunt than with series motors because the counter E.M.F. of the latter depends upon the current as well as the speed, and it might be posible, if the motor is starting under heavy overload, to obtain sufficient counter E.M.F. to close all the contactors before the motor has had time to accelerate properly.

The proper closing of the contactors used to short-circuit steps of starting resistance is accomplished by connecting the contactor coils in multiple across the armature, the contactors being adjusted to provide different air-gaps between the core and the armature of the contactors in the open position.

As the motor accelerates, the contactor having the smallest

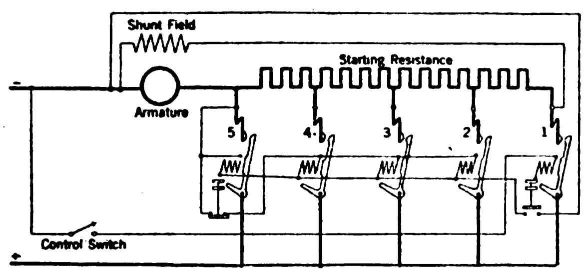


FIG. 1.—COUNTER E.M.F. METHOD OF CONTROL.

air-gap will close first, short-circuiting a portion of the resistance, which continues the acceleration of the motor. As the counter E.M.F. increases, the next contactor will close, and this is repeated until all the resistance is short-circuited. Sometimes instead of adjusting the air-gap between the core and armature, contactor coils are used which have different ampere-turns. A typical connection for counter E.M.F. control is shown in Fig. 1.

As the counter E.M.F. of a shunt motor varies directly with the speed for a given field of strength, it is necessary that the speed be fairly constant in order that the contactors will operate properly.

Current-limit Method of Control.—There are two general methods of obtaining current-limit acceleration, one using one or more current-limit relays, which control the closing of accelerating contactors, and the second method using series contactors, which combine within themselves the functions of current-limiting relay and accelerating contactor.

The first method, as generally used for D.C. motor control, depends on current-limiting relays, which may be mechanically connected to the contactors so that after the contactor closes, its relay is released for operation after the armature current has dropped to a predetermined value, due to acceleration of the motor.

Series contactors, so called because the contactor coil winding is in series with the motor armature, can only be used for the accelerating points, making it necessary to close the main circuit by means of a shunt-wound contactor, knife switch, or equivalent (Fig. 2). This method has all the advantages of the current-limit relay scheme, using individual current-limit relays, and the wiring is much more simple.

For A.C. motors, different methods of control are required, depending on the type of motor.

Squirrel-cage Type of Motor.—The proper starting current is obtained by reducing the primary voltage impressed on the motor, by means of a resistance or an auto-transformer. A resistance transforms the energy of the excess voltage required for starting the motor into heat, while an auto-transformer acts as a step-down transformer with very little loss of energy. The auto-transformer (compensator) coils are provided with several taps to give different starting-current values. Two coils are used for two-phase motors and two or three coils may be used for a three-phase motor. For

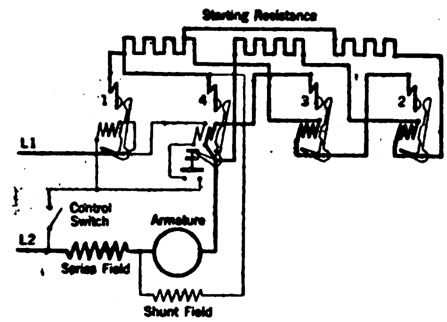


FIG. 2.—CURRENT LIMIT CONTROL USING SERIES CONTACTORS.

automatic control using either a resistance or an auto-transformer, contactors are used for first connecting the motor to the line through the starting element, and after the motor has accelerated, the second contactor is closed, connecting the motor directly to the line.

All sizes of motors require but one starting point because of the fact that any voltage which will start the average low-resistance motor will bring the motor nearly to normal speed. Either a time-limit or a current-limit relay may be used to energise the second contactor. For use with 2,200-volt motors, the contactors are immersed in oil to provide better insulation and to help rupture the arc. A potential transformer is used to reduce the voltage of the control circuit and a current transformer for operating the time-limit or current-limit relay.

Slip-ring Type of Motors.—These motors are started by means of a resistance connected to slip-rings on the motor shaft, which in turn are connected to the secondary circuits of the motor. As a general rule, both two- and three-phase motors are designed with a three-phase secondary and the resistance per phase is divided into steps, the number depending on the size and application of the motor. The closing of the accelerating contactors which short-circuit the resistance in the secondary circuit is generally controlled by means of two, or more, current-limiting relays, except in the

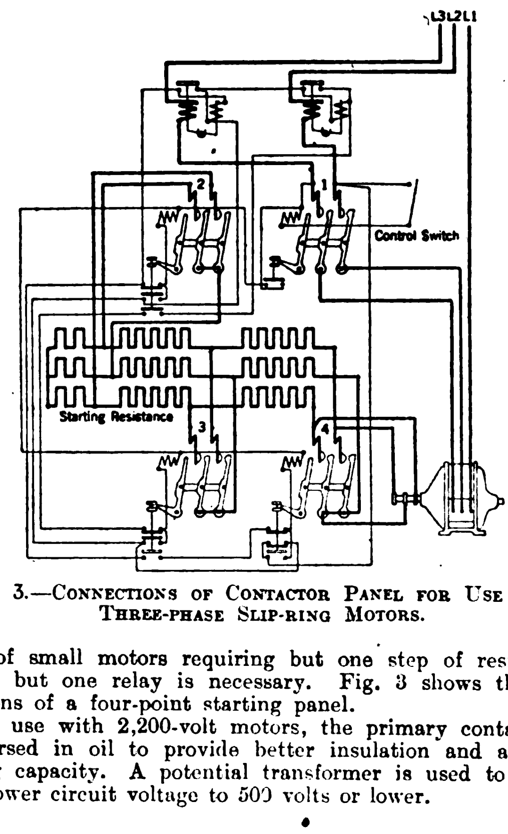


FIG. 3.—CONNECTIONS OF CONTACTOR PANEL FOR USE WITH THREE-PHASE SLIP-RING MOTORS.

case of small motors requiring but one step of resistance, where but one relay is necessary. Fig. 3 shows the connections of a four-point starting panel.

For use with 2,200-volt motors, the primary contactor is immersed in oil to provide better insulation and arc rupturing capacity. A potential transformer is used to reduce the power circuit voltage to 500 volts or lower.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Jan. 13th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

24,235/14. **Cable Insulation.** W. GEIPEL. Methods of improving the insulation resistance and durability of rubber-covered cables by consolidating the rubber upon the conductors prior to vulcanisation and in some cases during vulcanisation by direct action externally of a liquid under pressure.

24,746/14. **Telegraphy.** S. WECHSLER. A telegraph transmission instrument with a keyboard like that of a typewriter actuating contact devices so that when a key is depressed the dot-and-dash signal corresponding to the letter in question is sent, and a typewritten record of the message is made at the same time. (One figure.)

616/15. **Searchlights.** W. E. GRAY and W. BEST. An electrically-driven elevating and training gear for searchlights in which the motor is kept running at a constant speed and a continuously-variable ratio friction disc gear is interposed between the motor and the barrel. (Three figures.)

4,045/15. **Switches.** A. P., G. C., and P. A. LUNDBERG and G. PEGG. Increasing the carrying capacity of tumbler and similar switches by providing screens of insulating material round the path of the movable knife-blades to confine the arc formed on breaking circuit. (Three figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Dynamos, Motors, and Transformers: HUNT & SANDYCROFT, LTD. [Synchronous machines] 24,837/14; [Dynamo-electric machinery] 24,838/14 and [A.C. machines] 24,839/14; SIEMENS SCHUCKERTWERKE [Dynamo-electric machinery] 6,997/15 and [Slot-closing devices] 7,923/15.

Distribution Systems, Cables and Wires, Insulating Materials, &c.: BEAVER and CLAREMONT [Bonding cable armouring] 2,344/15.

Ignition: NORTH and ALLEN [Magnetos] 130/15.

Instruments and Meters: HAMILTON and FERRANTI, LTD. [Induction meters] 24,792/14; WESSEL [Slot-meters] 6,685/15; LANDIS & GYR A.G. [A.C. ampere-hour meters] 10,676/15.

Switchgear, Fuses, and Fittings: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Controllers] 491/15.

Miscellaneous: SIEMENS SCHUCKERTWERKE GES. [Stray wave protection devices] 723/15; GROGAN and THE BRITISH ELECTRIC TRANSFORMER Co. [Protection and indication of the condition of circuits] 2,570/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Heating: LANDIS & GYR A.G. [Heating device] 18,068/15.

Ignition: VAN DEVENTER [Ignition system] 13,391/15.

Opposition to Grant of Patent

23,244/14. **Tramcar Trucks.** E. PECKHAM and S. THOMAS. The grant of a patent on this application is opposed. The specification describes a system of flexible suspension of tramcar trucks.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: C. J. BEAVER and E. A. CLAREMONT [Copper-aluminium stranded cables] 20,447/08; J. S. HIGHFIELD [Flat multiple conductors with insulation moulded thereon by a squirting process] 22,287/09.

Incandescent Lamps: J. Y. JOHNSON [Treating metal filaments with phospam and similar compounds] 21,654/06; H. SEFTON-JONES (*H. Kuzel*) [Resoldering broken filaments to supports] 20,715/08.

Switchgear, Fuses, and Fittings: J. W. BROOKS [Conduit fittings] 21,604/06.

Traction: H. REID [Turbo-electric locomotive] 19,664/05; R. ABRAHAM and S. L. GLEN [Railway signalling] 20,619/08.

Miscellaneous: A. F. J. DOUTRE [Electrical control of aeroplane stability] 20,694/08; H. KNIGHT [Fire alarms] 22,378/09.

LIGHTING OF FACTORIES AND WORKSHOPS

THE Illuminating Engineering Society again discussed the question of industrial lighting at its meeting on Tuesday, January 11th. Since the subject was considered at the meeting of the Society in November, the third report of the Home Office Committee had been issued, and this contained many examples of the actual conditions in a large number of factories and workshops at the present time. The data thus compiled goes to show that the recommendations of minimum illumination in the Committee's first report are to a large extent met with in practice, or could easily be complied with by the aid of modern appliances. Mr. J. S. Dow, the assistant honorary secretary of the Society, opened the discussion on the 11th inst., but, taking the debate as a whole, it was evident that the problem of industrial lighting has now reached a point when it is more suitable for study by factory owners, lighting engineers, and lighting contractors than for further public discussion. Nevertheless, the discussion was interesting as showing the tendency which the lighting of factories seems now to be taking; in other words, the strong feeling which existed a short time ago for local lighting of the actual work in hand is gradually giving way to the claims of general illumination in which vast improvements have been made quite recently by the introduction of more scientific reflecting shades and globes, and also the greater efficiency of the smaller candle-power incandescent lamps as compared with arc lamps. At the same time there are industries which necessitate a certain amount of local lighting, and it is by reason of the fact that factories carrying out even the same class of work present different internal architectural features which renders it necessary for almost each case to be considered on its merits. The value of reflected light is also of increasing importance, and it is not uninteresting to note that in American factories not only the ceilings and walls but also the floor and the non-moving parts of machinery are painted in a light colour.

ELECTRICITY IN CHINA

MR. T. H. A. ALDRIDGE, the chief electrical engineer of Shanghai Municipality, who has just been in England placing orders, by consent of the Ministry of Munitions, for £225,000 of electrical machinery, has made some interesting observations in *Cassier's Engineering Monthly* on the general development of electricity in Chinese cities. An enormous amount of money has been wasted in these cities because there has been no guiding hand to point out which schemes are suitable and which are not. Tenders are asked for with only a very vague knowledge of what is required—for instance, for an installation to provide so many thousand lamps—and manufacturers cannot submit schemes they consider best because there is no one to judge them. In one instance a power station was built a long way from the river and on a hill, the worst place imaginable, the reason given being that somebody would be able to make a lot of money over coal transportation! The employment of consulting engineers, independent of any manufacturing interests, is badly needed. There is excellent material in China to work upon, and under proper direction the Chinese can be trained to perform responsible work. If China would less grudgingly open out the country and allow the foreigner to help to build up the industries, the great Chinese nation would forge ahead to an extent comparable with other progressive countries.

Electric Lighting of Railway Carriages.—As was to be anticipated, the recent railway accident at Jarrow has led to questions being asked in Parliament as to the steps which could be taken to accelerate the change in the lighting of trains from gas to electricity. Replying on behalf of the Board of Trade, Mr. Pretyman stated that considerable progress is being made in this direction, but that the work has been retarded owing to the shortage of labour brought about by the war.

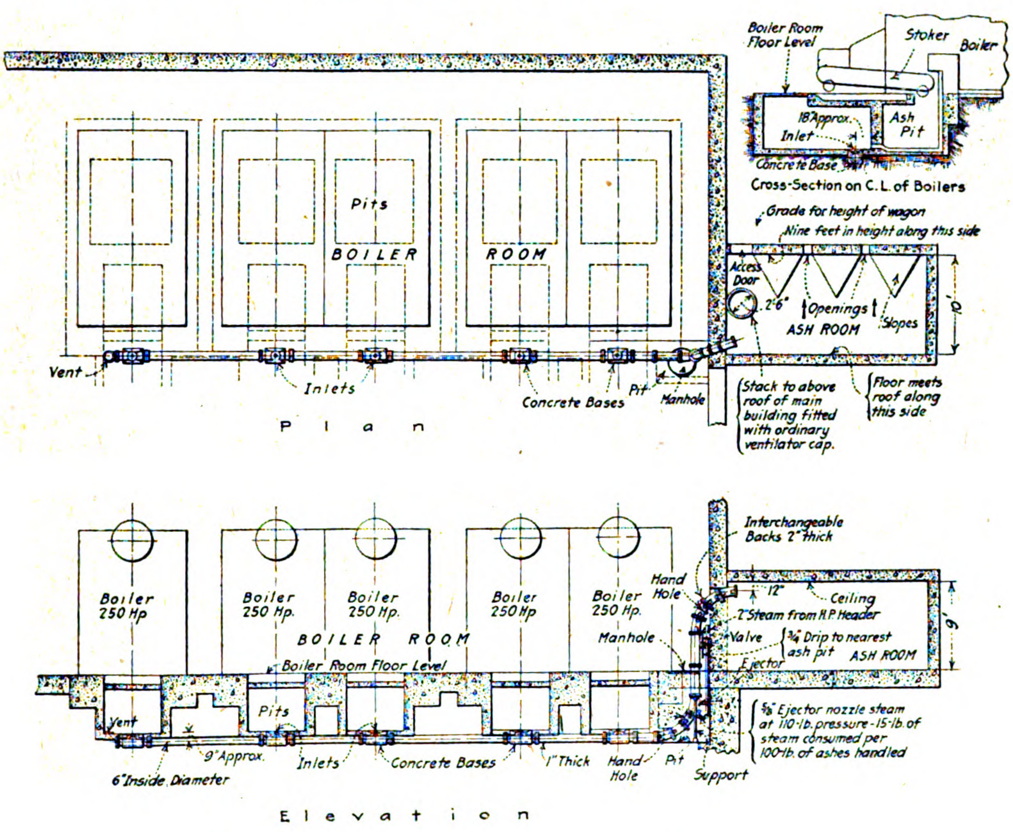
Electric-light Switching Competitions.—The next of these periodical events is now due, and Messrs. A. P. Lundberg & Sons, of 477-489 Liverpool Road, London, N., inform us that they will be pleased to send full particulars, including the problem or examination questions, to anyone at home or overseas desirous of the same.

THE VACUUM SYSTEM OF ASH REMOVAL

HITHERTO it has been assumed that the application of the vacuum system of ash removal is only applicable to large power-houses. In this country there are only two installations so far as we are aware, viz., at West Ham and the Newcastle-on-Tyne Electric Supply Co.'s Dunston power-house. We described the former in ELECTRICAL ENGINEERING, Vol. IX., June 12th, 1913, p. 341.

An interesting article by T. W. Reynolds, in the *Electrical World* of New York, however, describes the application of the system to small plants. The case in point is the removal of ashes under fire-tube boilers and stokers rated at 250 h.p. each in the power-house of the Missouri State Capitol, Jefferson City, Mo. The plant is illustrated in the accompanying drawing. The ashes are raked forward from the ash-pits to the inlets of the horizontal pipe-line shown on the plan and section drawings in front of the boilers. The inlets to this pipe-line are enclosed in concrete bases and open upwards floor. Hand-holes are placed in elbows, one on the inside radius of each bend. A steam-control valve is placed above the floor on a 2-in. line, which connects to the high-pressure steam header. The vertical steam drop is provided with a $\frac{3}{4}$-in. drop pipe and valve at a point above the control valve which leads to the nearest ash-pit. A support for the riser is required, and is installed as shown in the diagram.

The system is vented at the beginning of its run in the first ash-pit, and also by a stack 30 in. in diameter installed over and opening into the ash-room well back from the wall against which the ashes impinge. With this arrangement little dust is blown into the outside atmosphere. The access door of this room is near the main building wall for the same reason. The stack is provided with a ventilating cap at a point slightly above the roof of the main building. This ventilator is merely an outlet for the injected steam, and is made of a size sufficient to reduce the velocity of escape and eliminate dust. No movable or special ventilators are needed.



into the ash-pits. From these points the ashes are drawn by suction through the pipe to the ash-room.

The ash-room is built of concrete, 10 ft. by 20 ft. in size, 9 ft. in height on the delivery side, and provided with a floor which slopes upward to the roof at the other side. The sides of this ash-room are sloped so that delivery of ashes can be made through openings over wagons at a grade below equivalent to the height of the wagons.

The pipe which discharges the ashes enters the ash-room about 1 ft. below the roof, and is turned at an angle, as shown in the elevation drawing. The vacuum in the ash-delivery line is produced in the riser section by the injection of steam at a pressure of 110 lb. through a $\frac{5}{8}$-in. nozzle and ejector fitting. Steam at lower pressures may, however, be used. Fifteen pounds of steam are condensed for 100 lb. of ashes handled with a nozzle pressure of about 110 lb.

The delivery pipe is of special chilled iron selected to withstand the abrasive action caused by rapidly moving ashes. The straight run of the pipe is 6 in. inside diameter with a 1 in. thickness of metal. The radii of the bends at the discharge end are 4 ft. to the centre of the pipe, and made up of $22\frac{1}{2}°$ units or elbows. The backs of these are interchangeable, since these are points of wear, and reinforced by 2-in. thickness of chilled material designed to withstand the wear due to conveying at least 4,000 tons of ashes.

The elbows and ejector nozzle below the floor are installed in a pit accessible through a manhole in the boiler-room

The cost of handling ashes by means of this system has made its operation attractive, apart from the low installation cost and maintenance due to absence of mechanical parts.

Institution of Electrical Engineers.—The following is the result of the ballot for the election of new members and for transfers from one class to another at the meeting on Thursday:—*Member*—J. S. Jones. *Associate Members*—W. G. Covell, J. J. Gilmore, Capt. R. K. Rice, R.N., G. C. Shankster, C. E. Stuart. *Associate*—W. B. Shrimpton. *Graduates*—C. F. Boak, S. Brook, J. F. McEntee, G. MacIndoe, T. L. Naylor, W. E. Owen. *Students*—E. Braathen, M. L. Feest, E. A. Gleaves, W. H. Godwin, H. Pollard, G. M. Ross, F. Thomas, S. Young.

CANDIDATES TRANSFERRED.—*From Associate Member to Member*—H. M. Dowsett, W. H. Perrow, J. G. Thomas, J. G. Wilson. *From Graduate to Associate Member*—G. N. Hurst, W. R. Lewis, K. C. Mittra. *From Student to Associate Member*—C. G. Calman, P. J. Cottle, W. H. Date, T. A. Dixon, C. A. Elkins, J. R. Fletcher, D. H. Linsley, W. H. Lovell, N. H. Morris, A. M. Morrison, W. Parry, A. T. Robertson, G. H. Wood. *From Student to Graduate*—W. H. Blythe, V. O. Haddock, H. Honey, E. T. King, J. M. Parikh, D. D. Rayner, H. R. Sparrow.

The Middlesbrough Trolley 'Bus Scheme.—Owing to the inability of the contractors to supply certain parts of the motors, the trolley 'bus scheme for connecting Middlesbrough with South Bank, Grangetown, and Eston is held up. Everything is in readiness awaiting delivery of the cars, but these are not now expected for several months.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

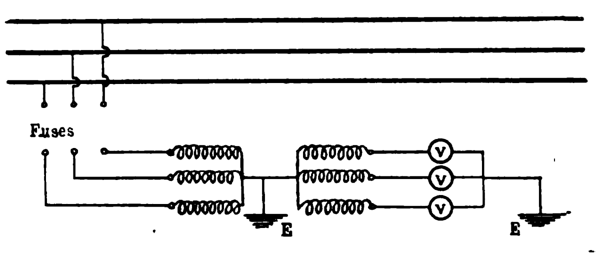
QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,478.

In a three-phase system, 6,500 volts between phases, and neutral point insulated, three voltmeters are connected to the 'bus-bars through star-connected 3-phase potential transformers, as shown in the diagram, to act as earth detectors. The normal



readings are 3,800. On removing two of the three fuses readings were still obtained on all three instruments, as follows :—

Fuse A only in: A, 3,800; B, 2,800; C, 900.
Fuse B only in: A, 1900; B, 3,800; C, 1,900.
Fuse C only in: A, 900; B, 2,800; C, 3,800.

(1) Why was there any reading at all? (2) Why were the readings with fuse B only in different to those with fuses A or C only in? (3) Would there be a possibility of damage to the voltmeter by only having one fuse in?—E. B. P.

(Replies must be received not later than first post, Thursday, Jan. 27th.)

ANSWERS TO No. 1,476.

In an A.C.-D.C. motor generator, which was disconnected from the supply and reconnected again, the connections were accidentally changed, so that the machine ran in the wrong direction. No current could be obtained from the D.C. side. Why was this?

The first award (10s.) is given to "Alpha" for the following reply :—

When a D.C. generator is run up to speed in the direction for which it is designed, the residual magnetism of the field magnets induces a small E.M.F. in the armature. The shunt field windings being connected across the terminals of the machine, this E.M.F. causes a small current to flow through them, and the connections are so made that the magnetomotive force this produces will assist the residual magnetism. The flux and the induced E.M.F. are thus increased, with the result that the shunt field current also increases, and the machine thus builds up its voltage until a point is reached where the E.M.F. induced is just equal to the *CR* drop in the shunt field and rheostat. If, now, the rotation of the generator be reversed without changing the shunt field connections, it is evident that the induced E.M.F. in the armature and the resulting field current will be in the opposite direction to the previous case. The E.M.F. due to the shunt field ampere turns will therefore oppose the residual magnetism and reduce the flux, this in turn reducing the induced E.M.F. and the shunt field current, but the shunt field M.M.F. will continue to oppose the resultant flux until the flux, E.M.F., and field current have all died away practically to zero. It will be evident from this that, if the generator is run in the wrong direction, it is impossible for it to give any voltage, since any tendency to generate an E.M.F. at once gives rise to a shunt field current tending to wipe out the E.M.F. By changing the field connections so as to reverse the polarity of the field, the machine could be operated in the reverse direction, since the induced M.M.F. would then assist the initial flux. As, however, the setting of the brushes, &c., will have been adjusted for the original direction of rotation, it would be decidedly preferable not to change the field connections, but to reverse two of the A.C. supply leads to the motor, thus giving the correct rotation.

The second award (5s.) is made to "Test" for the following reply :—

When the generator is run in the opposite direction of rotation no current can be obtained from it, as the residual magnetism in the poles due to its previous excitation is of the wrong polarity for the voltage of the machine to "build up." The armature conductors, cutting the residual field in the wrong direction, will produce a voltage across the shunt winding, which tends to excite the poles oppositely to the residual field. This field, opposing the residual field, is clearly dependent on the residual field for its existence; hence the voltage will not "build up" until the residual field has been changed. This can be done by separately exciting for a few seconds until the proper residual polarity is established.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Electrical Engineering. By T. C. Baillie. Vol. I., Introductory. 236 pp. 9 in. by 5¾ in. 131 figures. (Cambridge: The University Press.) 5s. net; abroad, 5s. 5d.

The treatment of the subject is for the most part good and clear, and although the book is Vol. I. of a series, and labelled "Introductory," it gives the student more than a good groundwork upon which to build his study of electrical engineering. No indication is given, however, as to the number and scope of the succeeding volumes. Without wishing to be unduly critical of an otherwise good book, there are two points to which we feel bound to call attention. Although the author uses the potentiometer freely in order to give the student sound ideas as to the importance of accurate measurements, he makes the grave error of stating bluntly that "the terms electromotive force and difference of potential are strictly interchangeable whenever they occur." Yet, only a few pages later, in one of the "Exercises," the student has to work out that a battery of 10 volts E.M.F. when connected to certain resistances has a potential difference of six volts at its terminals. The other defect is one which is unfortunately common in many class books, viz., that, in the exercises following the various chapters, frequent mention is made of apparatus which has not been previously described. It is, for instance, distinctly inadvisable to floor a student with a question involving the term field coils of an alternator, when he has only just struggled through the initial conception of Ohm's law and cannot have the remotest idea, from the instruction already given him, as to what an alternator is or whether its field coil is an animal or vegetable.

Continuous and Alternating Current Machinery Problems. By W. T. Ryan. 37 pp 7¾ in. by 5¼ in. 7 figures. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd.) 2s. 6d. net; by post, 2s. 8d.

THIS little book is a collection of elementary problems on continuous and alternating currents, D.C. machines, A.C. generators, motors, and transformers. Answers are not included, but hints are given occasionally as the solution. In general, the problems are closely related to engineering practice, and are made up so as not to be mere mathematical exercises. The book has been prepared for use with a particular text-book, though it would form a useful addition to any lecture and laboratory course.

U.S.A. BUREAU OF STANDARDS

THAT the U.S.A. Government is fully alive to the national importance of maintaining a high standard of technical and scientific progress is shown by the support and encouragement it gives to the Bureau of Standards at Washington. This institution corresponds roughly with our National Physical Laboratory, though the scope of the latter is unfortunately limited by the small amount of financial support given to it—probably not more than one-seventh of that received by the U.S.A. Bureau. The *Electrical World* has recently published interesting articles on the organisation and work of the Standards Bureau.

In the first definite plan of organisation the work of the electrical division of the Bureau was divided into two parts: (1) The construction and verification of resistance standards and standards of electromotive force, the calibration of resistance boxes, Wheatstone bridges, potentiometers and other resistance apparatus, and the calibration of direct-current measuring instruments and resistance standards for current measurement, while, in addition, facilities were provided for the verification of photometric standards; (2) the measurement of electrical inductances and capacities and the testing of inductance coils and condensers, and the preparation for alternating-current measurements of a wider range.

Later in the history of the Bureau the electrical work was divided into five principal sections, the first dealing with resistance and electromotive force, the second with magnetism, the third with inductance and capacity, the fourth with a wide range of electrical measuring instruments, and the fifth with photometry. Three kinds of work were undertaken: (1) Pure research; (2) the investigation of methods of measurement and of testing, the design and construction of instruments for use in testing; and (3) the testing of instruments and materials for the public and the departments of the Government. The broad lines thus laid down years ago have been followed in the substantial progress made by the Bureau in the last few years.

A list of the investigations now under way or completed during the last year by the electrical division includes: Weston standard cell, mercury standard ohm, silver voltameter, inductance of electrical resistance shunts, simple method for testing electrical-instrument transformers, measurement of earth resistivity, standard air electrical condensers, galvanometers, parallel-decade potentiometer, measurement of conductivity of electrolytes, resistance and inductance of bimetallic wires, magnetic method of determining flaws in steel rails, correlation of magnetic and mechanical properties, magnetic permeameters, temperature coefficient of magnetic permeability, core losses in iron at high inductions, radium testing, alpha-ray activity of uranium oxide powder, radium emanation, radio communication, radio interference, design of inductance coils for radio work, effect of atmospheric conditions on flame standards of candle-power, photometry of lights of appreciable colour differences, illuminating engineering, and lightning protection.

CATALOGUES, PAMPHLETS, &c., RECEIVED

ELECTRIC LAMP LOCKING RING.—From Mr. Charles H. Jeffcoat (18 Ranelagh Gardens, Hammersmith, W.) we have received an illustrated pamphlet describing the "Lamlok" electric lamp locking ring. The object of this is to prevent the pilfering or unauthorised removal of lamps, there being a special key for locking or unlocking the ring, an internal groove in which engages with the bayonet pins of the lamp.

CALENDARS, &c.

A composite desk companion from Messrs. Johnson & Phillip, Ltd., Charlton, S.E., consisting of diary, scribbling pad, a "standing memos." block, and an "Engagements—Don't Forget," is welcome, and can be promised full use. We have also to thank the firm for a well-bound pocket diary and engagement book.

Our thanks are due to Messrs. Alfred Graham and Co., St. Andrews Works, Crofton Park, S.E., for another of their desk blotting-pads and diaries, the predecessors of which have been of such good service to us. The pad is accompanied by a copy of the firm's book of speed and tide tables.

An embossed metal perpetual calendar from Messrs. Berry, Skinner & Co., 78 Upper Thames Street, London, E.C., has upon it a representation of a small ironsafe switchboard of a type of which this firm has been manufacturing many hundreds during the last two or three years.

Pirelli & Co., Ltd., of 144 Queen Victoria Street, E.C., have sent us a daily calendar mounted on a rectangular metal back 18 ins. high by 7¼ ins. wide and slightly concave. The illustration upon this is striking, consisting as it does of a Pirelli tyred wheel speeding along and having attached to it the flags of the Allies.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—An expenditure of £10,000 upon generating plant and £30,000 upon tramways has been sanctioned at Gisborne.

Bo'ness.—In connection with the recent proposal for a temporary extension of the Council's power station, which is worked by the National Electric Construction Co., it is now suggested that a permanent extension, with a 500-kw. generating set, should be made at an estimated cost of £14,000. The Council propose to call in a consulting engineer to report.

Halifax.—Twelve months' supply of stores for the Electricity Department, including E.H.T. 6,600-volt cable, low-tension cable, meters, &c. Borough Electrical Engineer. Feb. 14th. (See an advertisement on another page.)

An application is to be made to the Local Government Board for sanction to borrow £5,558 for new plant. The Tramways Committee also require extra-high-tension cable.

London: *Southwark.*—An application is to be made to the London County Council for sanction to a loan of £3,000 for mains, services, and meters, in addition to putting in order the capital account, which is at present overdrawn to the extent of £1,657.

Luton.—For the supply to Messrs. Hewlett & Blondeau (see "Local Notes") 2,300 yards of 6,000-volt cable is required.

Manchester.—Ash-handling telpher plant is required for the Stuart Street station. Further particulars from Chief Electrical Engineer, Dickinson Street, and tenders by Jan. 28th.

New Zealand.—The Public Works Office, Wellington, requires a 3,000-kw. generator in connection with the Lake Coleridge power scheme. A 4,300-h.p. water turbine is also required. Tenders by March 8th. This information is only of value to firms who can cable agents.

Wiring

Swansea.—Electric lighting of the Brymill Infants' School. Clerk, Education Department, 9 Grove Place. February 7th.

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. Wiring contractors are recommended to make inquiries to ascertain whether electrical work will be required.

Cardiff.—Alterations and additions at the Sanatorium. Town Clerk.

Dundee.—Children's hospital (£2,000).

Swansea.—Cinematograph theatre, £7,00.

Miscellaneous

Dublin.—The Electricity Committee require 50,000 pairs of arc lamp carbons for continuous-current lamps, and 62,000 pairs of carbons for flame lamps. Further particulars from the City Electrical Engineer, and tenders by Jan. 21st.

London: *Bermondsey.*—Twelve months' supply of electric lamps for the Guardians. Clerk, 283 Tooley Street, E.C. February 10th.

Middlesbrough.—The Corporation require a twelve months' supply of general stores, including electric lamps. Borough Engineer. February 7th.

APPOINTMENTS AND PERSONAL NOTES

Second-Lieutenant A. R. Courtenay (late Acting Manager of the Publication Department, General Electric Co., Ltd.) has now sailed for the Mediterranean. After about two months' active service in France with the Royal Naval Air Service, Armoured Car Aeroplane Support (Royal Naval Volunteer Reserve), he transferred to the Army Service Corps, and it is as a Second-Lieutenant in this Corps that he is now seeing service.

There are vacancies for electrician's wiremen. (See an advertisement on another page.)

LOCAL NOTES

Burton: *Increased Charges.*—At the last meeting of the Electricity Committee it was pointed out that the extra cost of generation for the current year will be £2,000, and that in consequence there must shortly be a revision of the electricity charges.

Dewsbury: *Second-hand Plant.*—The difficulty of obtaining new generating plant has caused the Electricity Committee to instruct the Engineer to purchase a second-hand generating set which has been offered from Dumbarton. This has already seen seven years' use, and the price arranged is £2,150. There was a good deal of opposition to the proposal when it came up at the last monthly meeting of the Corporation. Some critics held the view that the better course would have been to take a supply in bulk from the Yorkshire Electric Power Co., but eventually the proposal of the Committee was approved by a large majority.

Edinburgh: *The New Power Station.*—A sub-committee has reported upon the plans and estimates for the new generating station at Portobello, but before this report is discussed at a meeting of the Corporation it is to be printed and circulated among the members.

Glasgow: *Munition Workers Fined.*—At a local Munitions Tribunal last week twenty-four electrical workmen employed by Messrs. Alexander Stephen & Sons, shipbuilders, were fined for refusing to work overtime after 7.30 p.m. The case for the men was that they were entitled to be paid for the tea interval, but this, it was stated, was contrary to the practice of the establishment. In the case of four men the charge was withdrawn, as it was not proved that they had been ordered to work overtime. On behalf of the remainder it was claimed that the point was one which should go to arbitration, but the Court held otherwise, and fined each man 10s.

Lincoln: *Electricity Charges Increased.*—The Electricity Committee last week recommended an increase in the charges for electricity by 20 per cent. in the case of all consumers except those under contracts for power purposes. There was some opposition to the proposal in the Council, it being pointed out that this increase placed practically the whole of the extra cost of production upon users other than those for power purposes. A motion to refer the matter to the Council in committee, however, was negatived, and the scheme was sanctioned.

Liverpool: *Women Electricians.*—The scheme for training women as electrical wiremen, mentioned on page 492 of our issue of December 9th, has advanced a step further. Mr. A. Angers, of the Liverpool Branch of the Electrical Contractors' Association, has submitted a scheme to the Ministry of Munitions for the training of women from the age of twenty to twenty-eight for wiring work, on the understanding that the positions filled to enable a man to enlist should be vacated on his return to civil employment. A conference between the Electrical Contractors' Association and the Electrical Trades Union is suggested.

London: *Islington: Labour Troubles.*—The possibility of the electricity department employees coming out on strike seems to have passed away, for the notice given by the Municipal Employees' Association to "down tools" on Thursday last week was withdrawn. This action on the part of the electricity employees was part of a general agitation by the municipal employees of the borough for increased wages. It so happens, however, that the electrical employees have already been granted a war bonus, and were not at all inclined to follow the lead of the Union. The question of granting a further increase is now to be submitted to arbitration.

Marylebone: Pressure Testing Stations.—The Electricity Committee acquiesce in a suggestion from the Hackney Borough Council that the periodical inspection of pressure testing stations carried out under the direction of the London County Council should be suspended during the war in order that the undertaking might be saved the testing fees and the services of the officer engaged in collecting the records from the instruments utilised upon work of a more useful character.

Southwark: Electricity Deficit.—The accounts of the electric lighting undertaking for the year to March 31st, 1915, have just been presented, and show a net loss of £6,411.

Luton: *A Large Power Consumer.*—The Corporation has sanctioned an agreement with a large power user just outside the supply limits, subject to the necessary consent of the Board of Trade, which it is not to be anticipated will be withheld. The agreement is for fourteen years, the Corporation laying the necessary main, 2,300 yards, for the supply of 500 kw. The customer, however, who will advance the capital for this, the Corporation repaying during the fourteen years £80 per cent. of the annual net sum received from the customer, only contracts to take 100 kw. The total cost of the cable is estimated at £1,400. Supply is to be at 6,000 volts three-phase, the customer providing the converting plant. It is open to the Corporation to supply other customers through the cable, but an allowance will then be made to Messrs. Hewlett & Blondeau, the firm in question. The minimum payment by the Company for current is to be £1,750 during the first seven years.

Sheffield: *Kelham Island Power Station.*—The scheme for the transfer of the Kelham Island power station, formerly part of the tramways undertaking, to the electric supply department, will be the subject of a Local Government Board inquiry to-morrow (Friday).

West Bromwich: *Validity of Pre-War Contracts.*—The action between the Corporation and a local power-user in regard to the increased cost of electricity, referred to on page 507 of our issue of December 23rd, was again mentioned in Court on Friday. An application was made for the interim injunction restraining the Corporation from cutting off the supply to be continued until the trial of the action. On behalf of the Corporation it was stated that this was not necessary, as the Corporation was willing to agree to maintain the supply on present terms until the action was tried. This course was agreed to.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £114 to £116 (last week, £113 to £115).

Liquidations.—The Sheffield Electrical Engineering Co., Ltd., is in voluntary liquidation. Particulars of claims should be sent to the Liquidator, Mr. H. Cawood, 68 Eyre Street, Sheffield.

Bastian Meters.—In notifying us of an increase in the prices of their meters, the Bastian Meter Co., Ltd., of Bartholomew Works, Kentish Town, London, remind that this is really not an increase, as the prices were reduced in July, 1914. The effect of the war, however, on the cost of labour, raw material, carriage, and other items has made it impossible for them to maintain the reduction, and consequently the reversion is now made to what may be termed pre-war prices.

Pope Lamp Shades.—There has been such a demand for Pope lamp shades that the stock has been exhausted. Orders for printing further quantities are well in hand, however, and delivery has been promised for next week. Applications for supplies should be sent immediately to the Pope Electric Lamp Co., Ltd., Hythe Road, Willesden, N.W. The firm has just received a renewal of the contract with the Nelson Line for the supply of both carbon and filament lamps during 1916.

British Goods in China.—The Chinese Ministry of Agriculture has established a Commercial and Industrial Commission whose object is to collect statistics on the development of trade in China. This Commission desires to receive copies of catalogues issued by United Kingdom manufacturers. These should be addressed to the Commercial and Industrial Commission, Ministry of Agriculture and Commerce, Peking.

Agencies Wanted.—The Board of Trade have a number of applications from firms in all parts of the United Kingdom who wish to get into communication with United Kingdom manufacturers of goods previously obtained from Germany and Austria. Among the articles wanted in this way are electric pocket-lamps and bulbs.

NEW COMPANIES

SOUTH WALES & WEST OF ENGLAND WIRELESS TRAINING COLLEGE, Market Buildings, St. Mary's Street, Cardiff. Capital, £5,000. To adopt agreements with the South Wales Wireless Training College and J. R. Schofield.

ELECTRICAL ENGINEERING

With which is Incorporated

THE ELECTRICAL ENGINEER

(Established 1884)

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SUMMARY

There are indications that the B.E.A.M.A. may come into line with the Manchester Engineers' Club as to the steps to be taken to improve the position of the engineering industries in the world's markets after the war (p. 30).

Some books are reviewed on p. 30.

We publish a description of the electrification of the Manchester to Bury section of the Lancashire and Yorkshire Railway. Twenty-two miles of single track have been electrified, this being the first stage of a larger electrification scheme for the Manchester district. Power is generated at 6,600 volts A.C., and is transformed down and converted at two sub-stations to continuous current, which is supplied to a live rail at 1,200 volts. The return is by the track rails, and by a fourth rail placed between them (p. 31).

Our "Questions and Answers" page this week deals with the comparative merits of individual and group driving of machine tools in a small repair shop (p. 33).

A letter from Mr. J. Shepherd refers to the subject of suction ash conveyors (p. 33).

Among the subjects of specifications published at the Patent Office last Thursday were cascade motors, controllers, and circuit protection. A patent for loading duplex telephone circuits is opposed, and one for water-cooling turbo-generator armatures has been granted in spite of opposition. An application has been made for the revocation of a patent for a system of electrical mine signalling (p. 34).

Mr. Frank Broadbent quotes some startling figures in an article on "Unfair Handicaps to British Export Trade" in the current number of the *B.E.A.M.A. Journal* (p. 34).

Mr. H. H. Harrison gave a comprehensive review of the history and development of printing telegraphy to the Institution of Electrical Engineers on Thursday. He believes the type bar page printer will come to be the pattern adopted in preference to page or tape printing. In the discussion, credit was claimed for the British Post Office for the encouragement it has given to type-printing telegraphy, although it was admitted that the policy has been not to take up any system until it has been proved a success (p. 35).

New generating plant is required at Glasgow and Torquay; mains at St. Pancras; telephone switchboard at Brisbane; and stores in various places (p. 36).

Electric supply charges at Brighton have been the cause of some discussion. A proposal to abolish the maximum demand system has been referred back (p. 36).

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

(*To-day*) *Thurs., Jan. 27th:* Shooting for Sections I. and II. and Signalling Class.

Fri., Jan. 28th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Jan. 29th: Uniform parade, 2.45 p.m.

Mon., Jan. 31st: Sections I. and II., technical. Sections III. and IV., lashings and trestle bridging. Signalling class and recruits.

Tues., Feb. 1st: School of Arms, 6.0 to 7.0 p.m.

Thurs., Feb. 3rd: Shooting for Sections III. and IV.

Fri., Feb. 4th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Feb. 5th: Adjutant's instruction class at 2.30 p.m. Sections for technical parade at Headquarters, London Electrical Engineers, 40 Regent Street, S.W.

Sections for shooting parade at miniature ranges.

Unless otherwise ordered, all parades at Chester House.

Arrangements for the Week.—*Saturday, Jan. 29th.*—Association of Mining Electrical Engineers. Notts and Derbyshire Branch. At University College, Nottingham. "Unusual Breakdowns in Colliery Electrical Plant," by R. Devine. 3.30 p.m.

Tuesday, Feb. 1st.—Institution of Railway Signal Engineers. At I.E.E., Victoria Embankment. Impromptu discussion. 2.30 p.m.

University College Lectures.—Owing to circumstances arising out of the war, Mr. Kilburn Scott's course of lectures on the "Electrical Production of Nitrates for Fertilisers and Explosives," announced to begin on Wednesday, January 26th, will not be held.

PREPARATION FOR TRADE AFTER THE WAR

The B.E.A.M.A. and the Manchester Proposals

It will be remembered that the Manchester Engineers' Club has formulated in some detail a scheme for a general organisation of the engineering industry which has received wide support, especially in the Midlands and North of England. When we reviewed this scheme (November 25th, 1915, p. 468) we pointed out that, to be effective, it would almost necessarily involve the disappearance or absorption of such associations as the British Electrical & Allied Manufacturers' Association—at any rate, it would require an adhesion of this powerful Association to the proposed new organisation, with such modifications in its constitution and methods as to bring it into harmony and intimate working relations with the new body. From a few words let fall by the Chairman of the B.E.A.M.A. (Mr. F. R. Davenport) at a dinner held on Thursday last, it would appear that the matter had already been considered and discussed to some extent by the B.E.A.M.A., who were "perfectly ready to join any properly founded and organised central association." Mr. Davenport did not say specifically that it was the Manchester Engineers' Club proposals which he had in mind in referring to a central association, but it seems probable that this is the case, and we cannot but think that the issue of a definite statement both from the Manchester Engineers' Club and the B.E.A.M.A. would now be advisable as to the progress made, so as to save waste of labour by the initiation of a number of other schemes with similar objects in view. Some sort of central organisation is undoubtedly necessary, and although it might appear primarily and logically a task which the Government should undertake for the good of the whole industry of the country, yet it must not be forgotten that the hands of the Cabinet are now rather full, and the matter must not be allowed to wait too long. An organisation such as that suggested by the Manchester Engineers' Club, if adhered to by all the great manufacturing firms of the country and governed by a powerful and efficient central body, would not only meet the case, but would be a less cumbrous machine than a Government department.

At the B.E.A.M.A. dinner on Saturday there was an unusually large attendance of electrical manufacturers, including some from Manchester, which pointed to the possibility of a conference on the above subject having taken place earlier in the day. In addition, the following guests were present :—

Mr. Henry Thornton (General Manager of the Great Eastern Railway), Mr. S. Z. de Ferranti, Mr. Charles H. Merz, Sir Geo. Riddell (Managing Director, *News of the World*), Mr. Jean Cassel (interested in Anglo-Belgian industrial enterprises and finance), Mr. H. Muller (partner of Jean Cassel and Halot Mullier & Co.), Mr. Alex. Spencer (George Spencer, Moulton & Co., Ltd.), Messrs. F. Dudley Docker and Percy Wheeler (Metropolitan Carriage, Wagon & Finance Co.), Mr. C. H. Walker (C. H. Walker & Co., Public Works Contractors), Mr. W. W. Mitchell (Norton, Griffith & Co., public works contractors), Mr. H. Gordon Selfridge, Mr. C. H. Thurston (mining engineer, Consolidated Gold Field of South Africa), Mr. Robertson F. Gibb (joint manager, Union-Castle Line), Mr. G. T. Haycraft (director New Zealand Steamship Co.), Mr. W. H. Trinder (Trinder, Anderson & Co., vice-chairman of the Australian Shipowners' Conference), Mr. C. E. Alexander (Alfred Alexander & Co., glass bottle industry), Mr. F. E. Drake (United States Rubber Co.), Mr. T. W. Alsop (general manager, Falkirk Iron Co.), Mr. Stafford Ransome (secretary, British Engineers' Association), Mr. A. W. Tait (G. A. Touche & Co., and director of Ferranti, Ltd.), Mr. Martin C. Olsson (Martin Olsson & Sons), and Mr. F. W. Wile (formerly Berlin correspondent of the *Daily Mail*).

After Mr. Davenport had made a few introductory remarks, including the observation with regard to the possibility of the B.E.A.M.A. joining a central association as mentioned above, MR. HENRY THORNTON opened a discussion on the question of preparation for trade after the war. He said that there was unnecessary fear as to difficulties in finding the necessary capital when the time came. There should be no difficulty, however, as we had as assets gold credit, a navy to protect our trade, Colonies with immense resources, experience in trading abroad, and a population accustomed to industrial pursuits and of indomitable courage. He referred to the recent formation of the American Industrial Corporation, which combined manufacturing, transportation, shipping, and banking interests, embracing one of the largest firms in each branch of industry (the General Electrical Company of Schenectady are the electrical firm in the combination). There was danger, he said, of similar attacks on German export trade by Great Britain being dissipated into a number of small schemes without tangible results. It was essential to have assistance from banking houses and shipping interests, as well as the help of the Government through their Consular service, &c. It needed someone to take hold of the thing in the same way that Lord Derby had managed our recruiting campaign.

MR. C. H. MERZ said that the interests both of manufacturers and purchasers suffered from the want of co-operation. He was always surprised at the number of people desiring to quote for comparatively small contracts. Competition had gone beyond the point at which it could be of advantage to the purchaser. Owing to over-competition and to Government restrictions on supply undertakings and power companies, the electrical industry had not been so successful here as it should have been, and an industry could not expect to be successful abroad if it were not successful at home.

MR. SELFRIDGE said that business people must fight the common enemy with just as much spirit and determination as those in the trenches who were fighting to protect our homes. For this business fight, however, we must not rely upon a Government of lawyers. In America nobody looked for the support of the Government in any direction, and business men had to form their own committees. Eastern conservatism and want of ideas and new methods must be altered, and those who are aggressive must not be held back by those who think that all is well already.

MR. COLTON (Westinghouse Co.) said that after the war we must be prepared for the German industries issuing an intimation that they were the victims of the military party.

MR. FERRANTI said that the B.E.A.M.A. had acted, and were still acting, in the right way to bring about success. Our first effort should be to assure our position in our home markets. Our industries should consist of some very large and prosperous concerns, and not of several poor and struggling concerns, all in competition for low prices. This was necessary in order to enable manufacturers to spend plenty of money for development work, so that they might put forth the most perfect product and capture the trade. Then they would have money for the development of the world's markets. We were too fond of two things : sport and half-measures. In golf one went about in a most complicated manner to secure a most simple result, merely the placing of a ball in a hole, and in busineso we were apt to adopt similar self-imposed handicaps. We shall, he said, be dealing with an enemy as unscrupulous and dirty in commerce as they are in the field. If one had vermin in a house, one did not use sportsmanlike and gentlemanly means to exterminate them. The Allies should exclude everything German from their empires, and German trade with us must be turned out in such a way that there should be no chance of recovery.

MR. WILE reminded Mr. Selfridge that the co-operation of Government in business was the cause of German success, that the German Government representatives abroad were particularly business-getters, that the German State-owned railways and canals, and the State-subsidised steamship companies, all helped to promote export trade.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Standard Handbook for Electrical Engineers. Edited by F. F. Fowle. 1,984 pp. 6¾ in. by 4¼ in. 1,516 figs. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) Fourth edition. 21s. net.

THIS is the fourth edition of one of the most complete of the numerous works of its class that has been published. There has been a good deal of revision in matters of detail to ensure the contents being thoroughly up to date and slight changes in the arrangement of the sections have added to its already high quality in this respect. In estimating the degree of usefulness of the work to engineers in this country one must realise that it deals entirely with American practice, which does not quite everywhere lie parallel to British conditions. Some of the tables, for example, employ different wire gauges, and, of course, American, and not British, standardisation units, &c., are referred to. There is, however, a great deal of equal value in any country, and the intrinsic merit of the work of the compiler and the distinguished band of specialists who are responsible for the various sections places the book in a high position among its competitors.

"Mechanical World" Pocket Diary and Year Book for 1916. 330 pp., 6¼ in. by 4 in. 91 figures. (Manchester: Emmott & Co., Ltd.) 6d. net; by post, 8½d.

This excellent little notebook makes its appearance for the twenty-ninth time this year. It has been kept up to date by the addition of various new features, including information on boiler scantlings, boiler mountings, &c.: a separate and enlarged section on Diesel engines; some notes on brazing and soldering; and several new tables relating to Lancashire and Cornish boilers, locomotive boilers, steel plates, friction clutches, and other matters. The book will doubtless maintain its position as one of the handiest little pocket books obtainable for practical engineers and draughtsmen.

THE FIRST ENGLISH HIGH TENSION D.C. RAILWAY

MANCHESTER now possesses for the first time an electrical train service in its suburban districts. The Lancashire & Yorkshire Railway Co. have electrified their Manchester to Bury section—22 miles of single track—and, in spite of the difficulties in carrying out new construction work during war-time, the work has been done very rapidly, for it is only eighteen months ago that the electrification was decided upon. The full service of electric trains is not to be put into force immediately, however, but 27 per cent. of the existing steam trains will be replaced by electric trains, and further electric trains will eventually be added to augment the present service by 25 per cent. When the full electric service is established there will be a ten minutes' service to Radcliffe, with every second train running through to Bury.

The main feature of interest in the scheme is the adoption of the continuous-current live-rail system at 1,200 volts, with track return augmented by a fourth rail. Power is generated by three-phase turbo-generators at 6,600 volts, 25 cycles per sec., and is transformed down and converted to continuous current at two sub-stations.

Track Construction.—A considerable departure has been made from previous practice in the case of the live rail,

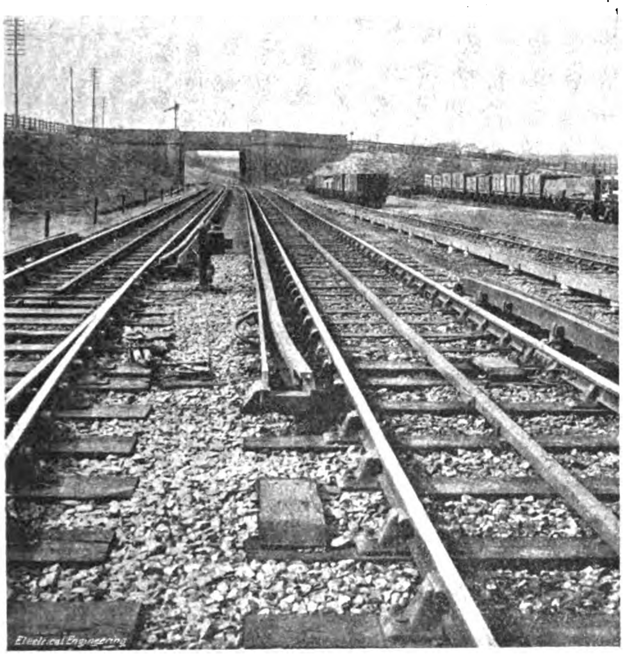

FIG. 1.—SECTION OF TRACK SHOWING 3RD AND 4TH RAILS.

which has a side-running contact instead of over- or under-running. This has been necessitated by the fact that with 1,200 volts, which is the maximum voltage allowed on third or live rails, adequate protection is required against shock, and this form of rail is admirably adapted for guarding, and at the same time gives larger clearances than the under-running type. The live rail with its guarding has been designed by Mr. J. A. F. Aspinall, the General Manager of the railway company. It is very compact, lying close to the running rail, and gives the maximum space for workmen in the six-foot, where the rail is normally fixed. The guarding is of Jarrah, which has been adopted for its non-combustible qualities. The rail rests on wooden packing pieces and porcelain insulators, the normal spacing of which is approximately 12 ft. The latter are of white porcelain, completely vitrified and glazed all over; they are 6½ in. high, and have a creeping surface 8 in. from metal to earth. They have been supplied by Messrs. Doulton & Co., Ltd., of Lambeth. The live rail is anchored every 100 yards by a specially designed insulator supplied by Messrs. Bullers, Ltd.

The rail, which has a resistance of from 6½ to 7 times that of copper of equal area, is in 60-ft. lengths, bonded at each joint with two "Forest City" bonds, each of 0·4 sq. in. section. The fourth or return rail is of square section with rounded corners, and weighs 88½ lb. per yard; its cross-section is 8·84 sq. in. Its conductivity is the same as that of the live rail, and it rests on wooden pads 1 in. thick, secured to the sleepers by iron dogs, and is placed between the running rails. This also has two bonds per joint, and is in lengths of 60 ft. Fig. 1 shows the arrangement of the live and return rails in relation to the track.

Trains.—The electric trains for the service, which have been built by the railway company, consist of either two,

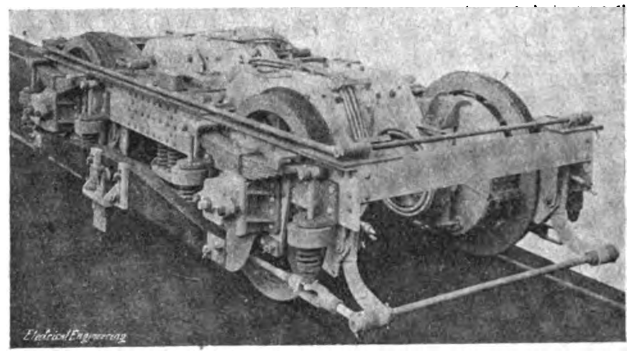

FIG. 2.—MOTOR BOGIE.

three, four, or five bogie cars, according to the requirements of traffic, but the standard train will have five cars, the front, centre, and the rear vehicles being motor-cars and the intervening ones trailers. A feature of the design is that there is a driving compartment at each end of each car, thus enabling the train to be made up to any accommodation required with the minimum of shunting operations. The construction of the carriages is of special interest, as they are made entirely of metal, and are probably the first cars in the world in which metal has superseded wood entirely in the construction of railway vehicles; for although the "all-metal" car has been largely introduced in America, the term has been somewhat of a misnomer, as timber has been largely used for windows, seats, and other fittings. The framework of the cars is of steel, the panelling of the sides and roof of aluminium sheets, the interior work being finished with mouldings of steel and aluminium sections. The doors are also of steel, and all the inside furniture of polished aluminium. Besides being electrically heated (with radiators near the doors), the cars are fitted with electric fans, which can be switched on to work in either direction.

Motor Bogies.—Each motor-car is mounted on two bogies, each of which carries two 200-h.p. motors (see Fig. 2) geared to the axles through spur gearing, the ratio being 25 : 59. On each side of the track is mounted a shoe-beam carrying the collecting shoe. The provision of 800 h.p. per car is on account of the gradients being somewhat severe.

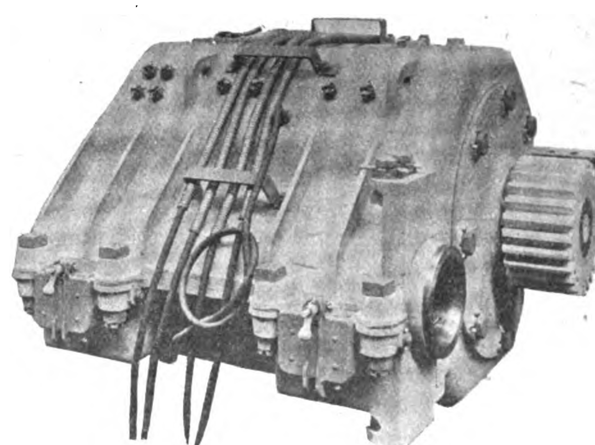

FIG. 3.—200-H.P. 1,200-VOLT MOTOR.

The wheel-base is 9 ft., diameter of the wheels 3 ft. 7 in., these being of standard locomotive pattern.

Motors.—The motors (Fig. 3) are designed for 1,200 volts; they are series wound with commutating poles, and are totally enclosed. The motor frame is in one piece of the "box" type, the armature being inserted from one end. The armature laminations are carried on a hollow spider, which also carries the commutator. This gives a rigid con-

struction, and permits of good ventilation of the armature. Solid mica insulation is used for the armature coils, and the field coils are enclosed in brass cases to protect them from oil. Ring lubrication is used for the armature shaft, the oil wells being of ample proportions; oil lubrication with pads is adopted for the suspension bearings. The brush gear is carried on a solid steel yoke bolted to the frame and in sulated from it with solid mica.

Control.—The control is by the multiple-unit system on the automatic principle—that is, instead of the motorman "notching up" in the usual way by hand, he puts his controller into the "full series" or "full parallel" position, the various intermediate steps being performed automatically. It can also be operated by hand by simply moving the reversing lever to a certain position. The whole of the equipment is operated by 100 volts D.C., which is transformed from the line voltage by means of a rotary transformer mounted under the car. All the 1,200-volt equipment is housed in a special high-tension chamber, the door of which is interlocked, so that the isolating switch connecting the control leads from the shoes must be opened before entrance can be effected. The high-tension wiring is carried in flexible steel tubing.

The brake valve is fitted with an emergency handle, which on release applies the brake instantly, and also trips the control circuit. It is contained in the driver's compartment, together with the master controller, a hand brake, and the switches for lighting and heating, as well as the automatic controller and regulator for the vacuum pump. The arrangement is the same at each end of the motor car, with the exception of the brake-pump controller. There are four series points on the controller, three series-parallel, and three parallel, with an additional two positions in which the fields of the motors are shunted when higher speed is required for express traffic.

Brake.—The brake is of the standard automatic vacuum type arranged so that it can still be effective when the ordinary steam-trailer cars are coupled to the trains. The vacuum is produced by means of a twin-cylinder exhauster, driven through gearing by a Mather & Platt 5-h.p. 100-volt motor.

The heating of the cars is operated off the 1,200-volt circuit, and the lighting and pump motor, as well as the control, off the 100-volt circuit.

Sub-stations.—There are two rotary converter sub-stations, one at Manchester (Victoria Station), and the other at Radcliffe, and both have batteries. The converters (Fig. 4), of which there are three at each sub-station, were supplied by Messrs. Dick, Kerr & Co., and are 1,000-kw. six-phase 25-cycle 10-pole machines, running at 300 r.p.m. Each has an overload capacity of 25 per cent. continuously and 100 per cent. momentarily. They are started by induction motors on the end of the main shaft, and are self-synchronising. No arrangements for starting from the D.C. side are provided. Three 350-k.v.a. Dick, Kerr transformers are used for each rotary, transforming down from 6,600 to 900 volts. They are of the oil-cooled type in sheet-steel cases with external radiating tubes. The terminals for both the primary and secondary leads are brought through porcelain insulators at the top of the case, and connections are made on the high-tension side through short leads and trifurcating boxes to the three-core cables from the high-tension switchgear. The low-tension leads are taken to the starting pillar and thence to the rotary. The battery is housed in a separate building, and consists in each case of 580 "Plantide" cells by the Chloride Electrical Storage Co. The capacity is 500 ampere-hours on the one-hour rating, and the charging current can be raised up to 1,500 amperes for 15 seconds. The boxes are of such a size, however, that the capacity can be increased ultimately to 800 ampere-hours by the addition of more plates. Each battery is divided into two portions, which are connected through isolating switches. The high-voltage portion (600 to 1,200) is partitioned off by wooden railings with gates, which are kept locked so that access can only be obtained by authorised persons. An "Entz" booster of the automatic reversible type with carbon regulator, made by Messrs. Mather & Platt, is installed in the rotary room. This consists of three continuous-current machines, booster, motor, and exciter, coupled together and mounted on one bed-plate. The booster has an output of 900 amperes at 185 volts continuously, and it will give 2,000 amperes at 190 volts for 15 seconds. Its output for charging the battery is 300 amperes at 300 volts continuously, and the voltage can be raised to 400 for over-charging. The motor is capable of driving the booster at all loads when running off the 1,200-volts circuit at 520 r.p.m. The speed can be raised to 650 by means of a shunt regulator, in order to obtain the over-charge voltage. All the cables from the switchboard to the rotaries, transformers, boosters, &c., are carried in concrete ducts in the floor of the sub-station. These ducts are covered in by steel non-slip plates.

A combined charging and milking booster, also by Mather & Platt, is installed in the rotary room. This set is capable of charging up 50 cells which are connected to the "Entz" booster in two hours per day, charging 25 cells at a time and giving 45 amperes at 40 to 70 volts. The set is also capable of milking the cells with an output of 200 amperes at 2 to 14 volts.

(To be concluded.)

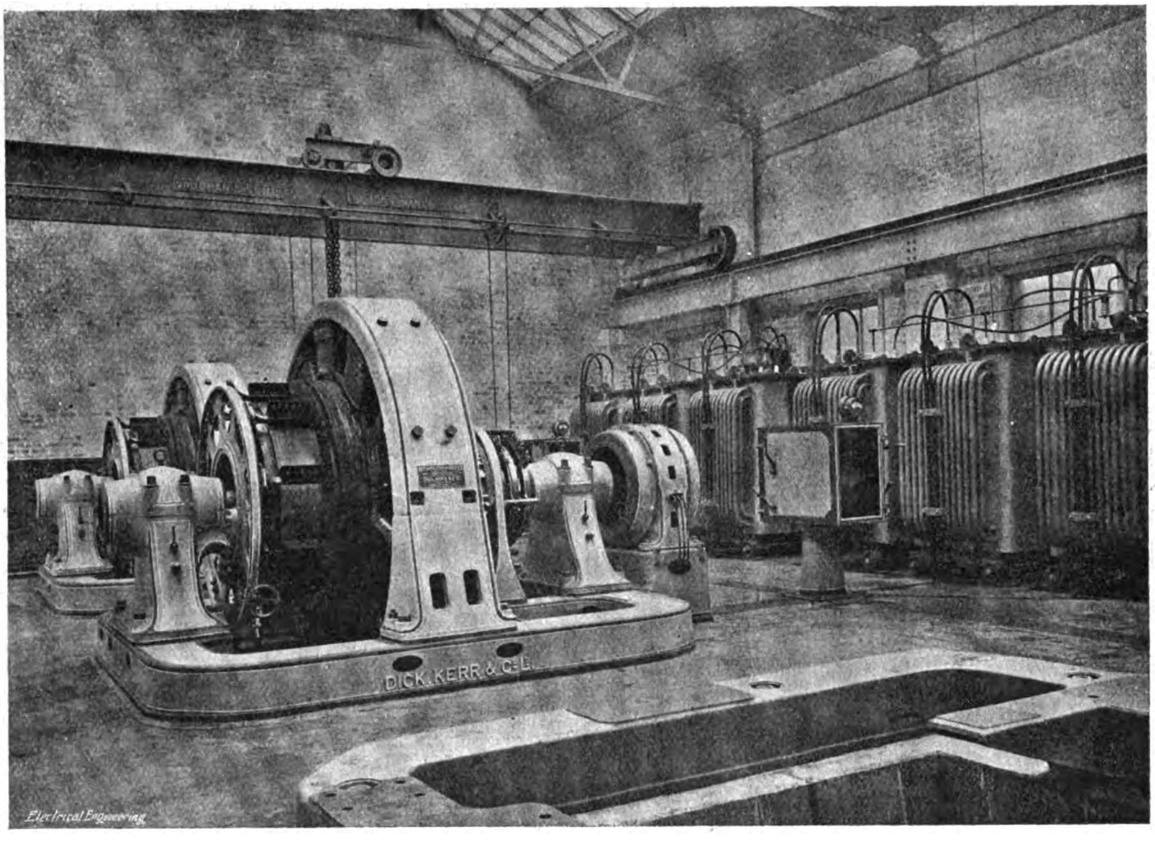

FIG. 4.—1,000-KW. ROTARIES AND TRANSFORMERS IN SUB-STATION.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,479.

Describe a simple but reliable test, for daily use, of switch and transformer oils, *i.e.*, flash point, and insulating and cooling properties.—W. E. L.

(*Replies must be received not later than first post, Thursday, Feb. 3rd.*)

ANSWERS TO No. 1,477.

It is proposed to erect a repair shop for a calico-printing works. The equipment will consist of three 2 ft. 6 in. centre lathes, a drilling-machine, a small plane, and possibly one or two other small machine tools. What are the points to be considered in deciding whether individual electric drive or a common drive from one motor will be preferable for these tools? (Answers are not to exceed 500 words in length.)

The first award (10s.) is made to "M. M." for the following reply:—

Individual, or at least group, driving would probably give the best all-round results; the writer would only suggest a combined drive under exceptional circumstances. Although ball bearings reduce shafting losses to a minimum, belts are always a continual source of annoyance and expense. Again, shafting and belting take up a large amount of room; there is a considerable increase in the number of parts on which depreciation has to be reckoned, and shafting often absorbs about 50 per cent. of the power. For the machines enumerated in the question, about 4 h.p. will be required; with a combined drive this would mean at least a 7-h.p. motor. With individual drive the lower efficiency of the small motors would be more than balanced by freedom from losses due to shafting.

A good arrangement would be to have separate motors for each lathe, and also for the drilling machine, the other machines being grouped and driven by a single motor. It is a great advantage to be able to run a single machine when on repairs, and for all-night and Sunday work it often happens that the drilling machine is the one most in request. With a combined drive, should anything happen to the motor, some makeshift is necessary if there is any turning to be done; either a small motor must be kept handy or manual energy must be employed.

Given individual drive, the operator can regulate his machine to suit his own special requirements; this is in many cases a distinct advantage. When the same lathe has to be used on the periphery of a large work as well as to turn the journals, there is a great difference in the angular velocities necessary to meet the different conditions.

There is no mention made of a blower for the blacksmith's shop; in repair work a small motor-driven blower is a boon to the fitter, and if separately driven can be put on and off as required. To run a whole plant all night on a repair job is wasteful; besides, with individual drive it is not likely that the repair shop itself will close down. Given a combined drive, the repair shop will be dependent on a single motor.

Should any rearrangement of the machinery in the repair shop be found necessary, with individual drive there is very little difficulty; electrical conductors can be taken practically anywhere, and that with facility.

Interpole motors will run satisfactorily at very great variations in revolutions per minute, and can readily be coupled to any machinery. Generally, except there are strong adverse local conditions, individual drive should be given the preference.

The second award (5s.) is made to "L. R." for the following:—

The arrangements to be adopted must be carefully considered, as the possible economies can be very easily swallowed up in losses due to interest, etc., upon the capital spent. Personally, I prefer direct driving of all machines, but in practice it is common to group together such machines as are similar in character, and that usually run simultaneously, and to drive them by a single motor, reserving the other machines for independent driving.

Several of the machines may have to stand idle for some considerable period of time, and in such cases as these it may be less expensive to provide interest upon the extra cost involved in the motor and switch than to pay for the driving of the shafting and countershafting continuously, whether fully loaded or not.

Another point is that different motors are best adapted for driving different machines. Thus for lathes, boring machines, and radial drills a variable speed shunt-wound motor is preferable, whereas for milling, shaping, and sawing machines an ordinary shunt motor suffices. For planing, slotting, or shearing machines one ordinarily employs a compound motor and flywheel.

One must also consider the position of the machine and the arrangement of the workshop.

With individual driving one can obtain more power, greater overload capacity, freedom from belt troubles, and fine gradations of speed with a suitable motor. This feature is important when one recollects that in a repair shop materials of considerably varying degrees of hardness have to be machined and a slight change in speed is often helpful.

In the present case only small powers come into question. Thus the lathes would only require about ½ h.p. each, and a similar figure would apply to a small drilling machine. Rather more would be necessary for the planer, say 2 h.p., and allowance must be made for additional machines.

It might be sufficient to drive the whole plant from a single motor, but it is suggested that in any event the planer should be separately driven. It is very annoying if one has fine work in the lathe for it to be upset by intermittent use of a machine, such as a planing machine, which will happen unless a considerable reserve of power be provided.

ANSWERS TO CORRESPONDENTS

PRISM and E. HUGHES.—We agree that the last sentence of "Test's" reply is incorrect. The obvious remedy is to connect up the A.C. side properly so that the machine runs in the proper direction.

CORRESPONDENCE

SUCTION ASH CONVEYORS.

To the Editor of ELECTRICAL ENGINEERING.

DEAR SIR,—I have read your interesting article on ash removal in your issue of the 20th inst., p. 25; the system proposed for the power plant of the Missouri State capital, Mo., is certainly simple,—whether it is effective is not stated. I should be inclined to think the 30″ vertical outlet would carry away quite an appreciable amount of dust, too much so to be tolerated here. In your notes on the system you say there are only two examples in this country so far as you are aware. I devised a third in 1910 for the Greenwich Station of the County Council Tramways, which was installed by Messrs. Keith & Blackman in 1911, serving 48 boilers and 24 economisers, and costing about £3,500; another plant has just been put in at the new power station at Clifton Junction for the L. & Y. Railway,—see *Engineering*, 14th inst., p. 30. Suction ash and dust plants do their work in a very thorough manner, but generally the upkeep is rather heavy.

Yours faithfully,
J. SHEPHERD.

32, 33, 34 Greek Street Chambers,
Leeds,
January 24th, 1916.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Jan. 20th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

24,837/14. **A.C. Motors.** L. J. HUNT and SANDYCROFT, LTD. A method of starting cascade motors provided with direct-current fields for running as synchronous machines at cascade speed according to which the slip-rings connected to opposite terminal points are coupled up in pairs to variable resistances adapted to be varied simultaneously while a switch is provided to short-circuit one set of terminals, leaving the other set connected in star through the resistances, so that the resistance can be gradually increased until the slip-rings are open-circuited. (One figure.)

491/15. **Motor Control.** B.T.-H. Co. (*G.E. Co., U.S.A.*) A control system comprising a controller arranged to advance automatically at a rate determined by an electromagnetic retarding device controlled by a relay responding to the motor current. (Three figures.)

723/15. **Circuit Protection.** SIEMENS SCHUCKERTWERKE. The protection of overhead lines from stray waves by means of vacuum relays each arranged in a magnetic field due to the conductor to be protected and adjusted to respond to the stray waves, but not to fluctuations in the magnetic field. (One figure.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: HUGHES [Arc lamps] 24,335/14.

Dynamos, Motors, and Transformers: VAN SWAAY and KEUS [Transformer] 484/15; KAPP [Phase advancers] 1,802/15; HORNBY [Motors] 4,564/15.

Storage Batteries: PATTERSON [Charging frames] 3,710/15.

Switchgear, Fuses, and Fittings: PRESSLAND [Cord grips] 188/15; FORRESTER (*Dunham*) [Joint for portable lamps, &c.] 15,081/15.

Telephony and Telegraphy: MORANO [Current modulators for microphones, &c.] 82/15; SIGNAL GES. [Wireless telegraphy] 398/15; RELAY AUTOMATIC TELEPHONE Co. and AITKEN, 580/15; DOD [Field telephone wire reel] 5,594/15; REID [Call recorder] 5,909/15; CONNER and KAHL [Telephone transmitters] 6,244/15.

Traction: WUILLOT [Car lighting and engine starting system] 190/15.

Miscellaneous: WALKER [Signalling apparatus] 3,774/15; J. A. SINCLAIR & Co. and SNELL [Magnetic compass] 7,153/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Arc Lamps: PLANIAWERKE A. G. FÜR KOHLENFABRIKATION [Arc lamp electrodes] 16,364/15.

Heating: ELMEN, SALISBURY, and TALBOT [Fluid heaters] 9,584/15.

Switchgear, &c.: BRITISH WESTINGHOUSE ELECT. & MNFG. Co. [Protective devices] 17,960/15.

Miscellaneous: NICOLSON & HULL [Electron-emitting cathodes] 17,530/15; WILSON, ANDERSON, & CURTIS [Electric welding] 17,833/15.

Amendments made

29,712/13. **Wireless Telegraphy.** R. C. GALLETTI and GALLETTI'S WIRELESS TELEGRAPH & TELEPHONE Co. This specification has been allowed to be amended by corrections in the drawings. It describes a system of transmission controlled by cutting in and out a high resistance circuit in shunt with the spark-gap.

Opposition to Grant of Patents

Opposition has been entered to the grant of a patent on the following application:—

22,554/14. **Telephony.** BRITISH INSULATED & HELSBY CABLES, LTD., W. P. FULLER, and H. H. HARRISON. Pupin coils for duplex telephone circuits loading the physical and phantom circuits by a single coil without the production of a stray field.

The grant of a patent on the following application has been allowed in spite of opposition:—

16,986/14. **Turbo-alternators.** SIR C. A. PARSONS. A system of water-cooling of turbo-generator armatures.

Application for Revocation

An application has been received for the revocation of the following patent:—

18,786/14. **Mine Signalling.** H. GREEN and W. DE M. LANDON. A system of mine shaft signalling with bells and luminous indicators controlled by relays.

The following are the more important patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: BROWN, BOVERI & CIE [Motor control] 20,827/08.

Electrochemistry and Electrometallurgy: R. J. LEVY [Electrolysis of sodium and other chlorides] 20,787/08.

Telephony and Telegraphy: D. SINCLAIR and W. AITKEN [Telephone meters] 20,968/08.

Miscellaneous: W. FAIRWEATHER [Electric clocks] 20,976/08; F. CASTLE [Fire alarms] 22,490/09.

THE B.E.A.M.A. JOURNAL

Unfair Handicaps to British Export Trade

AMONG a number of excellent articles in the January number of the quarterly *B.E.A.M.A. Journal* is one by Mr. Frank Broadbent on the handicaps to which the British export trade has been subjected at the hands of the railway, canal, and steamship companies. The fact that the average export rate per ton-mile on German State railways is less than half the British rate, and in some cases is below one-third of a penny, may be entirely due to the fact that the German railways are State-owned, so that the low rate is virtually a Government subsidy, but there is not so simple an explanation for the following facts cited. Although there are canals between Wolverhampton and London, German manufacturers could deliver goods in London at a lower cost than Wolverhampton manufacturers. Carriage from Birmingham to Dublin before the war was higher than from Nuremberg or Vienna to Dublin. Dynamos could be sent from Antwerp, Rotterdam, or Hamburg *viâ* London to New Zealand (including re-shipment in London) at 49s. per ton, while British dynamos sent direct from London to New Zealand were charged 62s. 6d. per ton. The corresponding figures for insulators and lamp fittings were 32s. 3d. and 47s. 6d., and for glassware 26s. 3d. and 38s. 9d. Goods could be shipped from New York *viâ* Liverpool to Sydney at 40s. to 42s. per ton, whilst British goods sent direct, in the same boats as the American, from Liverpool to Sydney, were charged at 45s. per ton.

The *Journal* also contains an article on Britain's neglect of science by Prof. Silvanus P. Thompson, and among the technical articles are "Power Factor Meters," by Dr. R. D. Gifford; "Automatic Control Gear for Use with Electric Motors in Industrial Work," by Mr. Frank Walker, and a description of the latest forms of Nalder Bros. & Thompson leakage indicator for A.C. circuits.

Electric Lighting of Railway Carriages.—At the resumed Board of Trade inquiry into the fatal railway accident at Jarrow on December 16th, the question of the lighting of the carriages naturally received a good deal of consideration. Mr. A. C. Stamer, acting chief engineer of the North Eastern Railway Co., stated that there are now 344 coaches fitted with electric light belonging to the Company, exclusive of those on Tyneside. He added that during the last three years all new passenger-carrying vehicles have been fitted with electric light and that all new stock is being dealt with in the same way.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

At the Institution of Electrical Engineers on Thursday, Mr. H. H. Harrison read a comprehensive Paper on "The Principles of Modern Printing Telegraphy." Consisting as it did of no fewer than 55 pages of the size of the Institution Journal, and containing 105 illustrations, it well deserved the encomiums which it received from Sir William Slingo (Engineer-in-Chief to the G.P.O.), Mr. Walter Judd (of the Eastern Telegraph), Mr. Donald Murray, and others intimately associated with the telegraph world, both land and submarine. Nothing approaching this Paper, either in point of size or information, has yet been published by the Institution, and such is the value placed upon it that the Papers Committee decided, at a time when the strictest economy is being practised, to publish it in full at a cost of £150. As one speaker put it, the Paper is an encyclopædia of the history and practice of printing telegraphy. Having said this, the difficulty in giving an adequate summary in the small space we have available will be appreciated. Mr. Harrison, himself the inventor of a printing telegraph system, divided the Paper into six parts, and traced the development from the early elementary forms to the present-day quadruple-duplex circuit. Over a period of about eighty years innumerable systems have been invented, but up to 1900 only two can be said to have achieved permanent success, viz., the Hughes, invented by the late Sir David Hughes as far back as 1854, and the multiple system of Baudot, first introduced since 1874. From this latter date onward high-capacity printing telegraph systems have been proposed, but they have all possessed some fundamental defect. One of the facts which forcibly strike the student of present-day printing telegraphy is the convergence of nearly all inventors towards the adoption of the five-unit alphabet. As a result there is close similarity between the devices employed in competing systems. This is not surprising, for, as was pointed out in Mr. Donald Murray's classical Paper on the subject before the Institution in February, 1905, given an alphabet, then the design of instruments produced to use it must proceed on certain lines. Mr. Harrison comes to the conclusion that the art of type-printing telegraphy has now reached such a stage of development that it is possible to answer many questions hitherto shrouded in the mists of doubt. The last few years have seen the triumphant advance of the five-unit equal-letter alphabet, although for military reasons, and also in the field of wireless telegraphy, hand Morse working will never entirely disappear. The modern multiple system with keyboard perforators, automatic stop and start of transmitter, and distributor driven by phonic wheel, will work regularly at 160 to 180 words per minute. It seems possible that this is not the attainable limit. The Siemens automatic system, using the electrical combiner which Baudot discarded, can work at this speed on one channel only. Thus it is clear that printer units can easily be made having a higher speed than 40 to 45 words per minute, and the only barrier to speeding up channels or adopting a large number of channels is the transmission limit of the line. The main telegraph circuits of this country are now run underground, and a lower speed of transmission is a necessary consequence. As to whether page or tape printing will predominate, the author has very little doubt that the type-bar page printer will come to be the pattern adopted; not that satisfactory type-wheel page printers cannot be made, but type printers, being in commercial demand by the million, we have a translating mechanism ready-made much more durable than any type-wheel apparatus can be.

There was a long and interesting discussion, in which Sir William Slingo, Col. Squier, Mr. Walter Judd, Mr. Donald Murray, Mr. Raymond Barker, Major Booth, and Mr. T. T. Tyrrell took part, and several others were prevented owing to lack of time. Sir William Slingo indulged in some interesting reminiscences of the reasons why the British Post Office did not adopt the printing telegraph earlier than it did, one of the main reasons being the conservatism of the British public towards a hand-written telegram as recently as twenty years ago. Now, however, a considerable advance has taken place in our ideas, and printed telegrams are now used to as large an extent in this country as elsewhere in the world. The Siemens automatic system, said Sir William, was one of the few novelties in the telegraphic world which came from Germany, but Mr. Harrison, in reply, said it was not altogether a novelty, as it was really only of one channel, Baudot. At the same time he agreed with Sir William Slingo that it is a particularly good system. Col. Squier pointed out that a vast reservoir of engineering and physical data had been collected in connection with wireless telegraphy which was available to aid improvements in ordinary telegraphy, and in this connection he mentioned the possibility of using frequencies above and below those at present used in telegraphy. On the application of printing telegraphs to submarine telegraphy, Mr. Walter Judd explained why a five-unit alphabet would not do. After Mr. Donald Murray and Mr. Raymond Barker had joined in the discussion without criticising in detail anything the author had said, Major Booth made a somewhat critical speech, and gave the British Post Office credit for helping materially in the development of the printing telegraph, incidentally remarking, however, that the Post Office could not afford to encourage inventors and "stand the racket." After a system was proved a success, the Post Office had never refused to give it a trial. This was in reply to Mr. Donald Murray, who had somewhat caustically mentioned the difficulties in getting the Post Office to take up a new thing.

The Hull Corporation Telephone Department's accounts show a net balance of £2,390 after meeting capital charges. There is difficulty in comparing the result of the year's working with previous years, as the figures include, for the first time, the Post Office system, which has been taken over. At the same time it is satisfactory to notice a profit compared with a small loss last year.

An interim dividend for 1915 of 5 per cent. is announced on the ordinary shares of Marconi's Wireless Telegraph Co.

CATALOGUES, PAMPHLETS, &c., RECEIVED

RHEOSTATS.—Special interest attaches to a catalogue from Messrs. Isenthal & Co. (Denzil Works, Willesden, London, N.W.) of an all-British type of rheostat. This piece of apparatus was formerly imported, but is now manufactured outright in this country. These rheostats are made in a number of types, but the general principle of them is that the resistance wire is wound on slate bars or slabs, the edges of which have been grooved so that the wire forms a continuous narrow pitch spiral. The bars are mounted according to requirements, in various ways, and thus constitute single, twin, universal, or ventilated rheostats. All are provided with a sufficient number of terminals to enable them to be used either in series or shunt (potentiometer connection). The two remaining sections of this list, which will be issued shortly, will deal wth field and arc lamp resistances, dimmers, and special types.

ELECTRIC LAMP LOCKING DEVICES.—We referred last week to the lamp locking device of Mr. Charles H. Jeffcoat, and are now informed that the Edison Swan United Electric Co., Ltd. (Ponders End, Middlesex), has taken up the sale of this, together with another device of Mr. Jeffcoat's which has already been illustrated in our columns. This latter is also a locking device, but of a different type to the ring, being, in fact, a lamp locking lamp-holder.

JOINTING MATERIALS.—Messrs. Siemens Brothers & Co., Ltd. (Woolwich), send us a reprint of pages 903–908 of their catalogue 510, giving revised prices of jointing materials, due to alterations in cost of materials, &c.

Institution of Electrical Engineers.—The following is the result of the ballot for new members, &c., at the meeting on Thursday:—*Members:* G. A. Juhlin, J. A. Kuyser. *Associates:* A. Pirelli, P. Pirelli. *Graduates:* S. Chakravarti, A. V. Hopkins, K. V. Nair, T. C. Schneidau, S. R. Tombat, H. J. Ward, L. E. Wood. *Students:* S. T. Burkitt, F. A. Cook, F. de Arana y Bengoechea, A. L. de Latheiros, H. Duckworth, F. Dunnill, H. I. Evernden, G. H. Fletcher, J. Galveas, J. J. Goodwin, A. Greenhill, N. R. Harben, R. H. Harral, A. Harrison, M. Hasselt, A. S. Hollin, F. R. Housden, G. G. Jacob, R. F. Japp, S. Lazarus, E. F. Malta, A. M. Martins, D. G. B. Partridge, H. S. Petch, E. K. Ramaswami, R. C. Read, L. C. Richards, R. C. Senior, W. Seaward, A. Serner, W. E. Sich, L. S. Smallcombe, H. L. Smith, H. H. Wall, C. E. Webb, J. S. Whitney, E. W. Workman, J. E. Wright.

CANDIDATES TRANSFERRED.—*Associate Member to Member:* E. Ambrose, W. Frisby, A. E. Grant, D. M. Macleod, S. W. Thomas, C. G. Watson. *Associate to Associate Member:* G. H. Vivian. *Graduate to Associate Member:* E. Greenhalgh. *Student to Associate Member:* C. G. Huntley, B. W. Leak, F. H. Mann, A. G. Ramsey, J. D. Ross, G. J. Scott, C. P. Tufnell, B. P. Walsh, H. Williams. *Student to Graduate:* I. B. Damania, R. E. Livesley, F. N. Mowdawalla, A. C. Pallot, B. Paul.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The New South Wales Government Railways & Tramways Department requires a 2,500-kw. turbo-alternator for the Zarra Street power-house, Newcastle, N.S.W. Tenders to Electrical Engineer, 61 Hunter Street, Sydney, by May 3rd. Further particulars at 72 Victoria Street, S.W.

Glasgow.—The Electricity Department recommends that two 8,000-kw. turbo-alternators be installed.

London: *St. Pancras.*—It is proposed to extend the feeders in the Northern and Prince of Wales Road district at an estimated cost of £4,526.

Torquay.—Additional plant is to be installed at the electricity works.

Miscellaneous

Australia.—The Deputy Postmaster-General at Brisbane requires five sections of trunk-line switchboard. Further particulars at 72 Victoria Street, S.W.

Birmingham.—The Birmingham Tame and Rea Drainage Board requires a twelve months' supply of electrical stores. Clerk, 117 Colmore Row, Birmingham. February 8th.

Halifax.—The Tramways Department requires a twelve months' supply of lighting fittings, insulating materials, vulcanised rubber cable, trolley and overhead line materials, &c. Tramways Engineer. February 14th.

Wigan.—The Tramways Department requires a twelve months' supply of overhead line material and other stores. General Manager. February 5th.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Barnsley.—The following tenders have been accepted in connection with the extensions at the electricity works:—Turbine, Willans & Robinson, £2,590; alternator, Dick Kerr & Co., £1,980; condenser, Willans & Robinson, £2,150; high- and low-tension cables, British Insulated & Helsby Cables, Ltd., £2,241.

Bath.—Messrs. Chamberlain & Hookham have received a twelve months" contract from the Corporation for direct-current meters.

Taunton.—A contract has been placed with Messrs. Chamberlain & Hookham for a twelve months' supply of direct-current meters.

LOCAL NOTES

Bedford: *W. H. Allen & Co.'s Plant.*—The Electricity Committee has been notified by Messrs. W. H. Allen, Son & Co. of their intention to put down an additional 250-kw. motor-generator in order that the firm's private generating plant may be shut down and the whole of their supply taken from the Corporation mains.

Brighton: *Increased Charges.*—For the third time since the war the Corporation is faced with the necessity for an increase in the charges in the electricity department. Mr. J. Christie, the Borough Electrical Engineer, has prepared a scheme, the objection to which, however, in the minds of many Brighton people, is that it places the burden of meeting the increase in cost of generation almost entirely on the private lighting consumer. In other words, the charge for street lighting remains untouched, the charge for traction is only slightly varied, whilst no addition is proposed in the case of power users. It is anticipated that the scheme which Mr. Christie has put forward will bring an additional £12,000 revenue. The maximum demand system is to be abandoned, and a flat rate for lighting of 5½d. per unit instituted. Mr. Christie regards the situation as giving an opportunity to get away from the varying tariffs now existing, but although his Committee agreed with him, they were unable to carry the Corporation with them when the matter came up for consideration last week. The whole matter was referred back, including a proposal to transfer £2,000 from the district funds to meet capital charges on the plant for street lighting. Many Councillors fear that the effect of the new tariff would be to drive large consumers to put down their own plant.

Ripon: *Electric Lighting.*—The Council is to be asked to appoint a Committee to investigate the possibility of obtaining a supply of electricity for the town.

Wigan: *Supply Interruption.*—There was a somewhat serious failure of supply on Friday, due, judging from the local paper reports, to a lack of boiler capacity. The Electricity Committee had during the afternoon issued a warning that there might be a stoppage. Two Lancashire boilers have been on order for some time, but have been delayed, and an attempt is now being made to obtain a supply from the South Lancashire Tramways Co.

APPOINTMENTS AND PERSONAL NOTES

At a meeting of the Council of the Royal Society of Arts on Monday, the Society's Albert Medal was presented to Professor Sir J. J. Thomson, F.R.S., "for his researches in chemistry and physics, and their application to the advancement of arts, manufactures, and commerce."

The following news of the staff of the County of London Electric Supply Co. serving with the Forces will be read with interest:—Mr. H. A. Moncrieff, secretarial department, formerly serving in France in the Queen's Westminsters, has obtained a commission in the 3rd Dorsets; Mr. F. H. Howell, secretarial department, bombardier in the 7th County of London (R.F.A.), has obtained a commission in the Royal Field Artillery; Mr. N. F. Gadstone, after service in France, has obtained a commission in the 4th Essex; Mr. Sydney A. Knight, secretarial department, after service in France, has been gazetted to the North Somerset Yeomanry; Mr. C. E. Scott, of the Putney Local Office, serving in the 23rd Middlesex Regiment, has been promoted to Regimental Quartermaster-Sergeant, and is now a second-class Warrant Officer; Mr. Alan Leigh, of the mains department, has been granted a commission in the 14th Service Battalion East Surrey Regiment. We regret to hear that the following employees in the mains department have been killed in action, all of the 9th Battalion (Buffs) East Kent Regiment:—H. Beazley, T. Hyam, R. Reeves.

The engineer and manager of the electricity department at Abertillery, Mr. D. Lloyd, has resigned.

The Swindow electricity department want a temporary switchboard attendant. (See an advertisement on another page.)

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £118 to £122 (last week, £114 to £116).

Plant for Sale.—The Salford Electricity Committee have a quantity of second-hand generating plant for sale. It can be seen by appointment working on load. (See an advertisement on another page.)

Agency.—A Montreal firm desires to represent United Kingdom manufacturers of all classes of electrical plant, including generators, steam turbines, transformers, meters, motors, &c. Further particulars at offices of High Commissioner for Canada, 19 Victoria Street, S.W.

Switzerland and German Accessories.—As has already been stated in our columns, owing to the lack of copper Germany is employing iron instead of brass for such things as lamp holders, shade galleries, lamp sockets, and other small accessories. Switzerland has hitherto been a large buyer of such electrical material from Germany, and we gather from reports received that the iron substitutes are not in all cases appreciated. Quite probably also the cost of various electrical accessories has been increased in consequence of the shortage of copper, and the matter should certainly be worth the attention of manufacturers over here, who might conceivably open up business relations with electrical firms using this class of material in Switzerland, with a view to keeping them as customers after the war.

ELECTRICAL ENGINEERING

With which is Incorporated

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SUMMARY

We conclude our description of the high-tension D.C. railway between Manchester and Bury. The new power station at Clifton Junction contains two 5,000-kw. turbo-generator sets, generating three-phase current at 6,600 volts 25 cycles (p. 38).

At an important meeting of business men from all parts of the country at the Guildhall, on Monday, resolutions were passed which, if pushed home in the right manner, leave the Government with very little excuse for not taking immediate steps to provide legislation which will protect British trade after the war from unfair foreign competition (p. 39).

In the course of a discussion on battery signalling bells at a meeting of the Association of Mining Electrical Engineers at Manchester, Mr. H. Green described a system of his invention which works on the closed-circuit relay principle, with only one live wire (p. 40).

At a meeting of the East Scotland Branch of the Association of Mining Electrical Engineers on Dec. 24th, a Paper on "Unusual Breakdowns in Colliery Electrical Plant" was read by Mr. R. Devine, who discussed a number of specific cases of breakdown which had come within his own experiences (p. 41).

In a Paper on "Electrical Shaft Winding," read before the Association of Mining Electrical Engineers on Jan. 22nd, Professor D. Burns made reference to the circumstances which occasionally make the use of steam preferable to electricity for shaft winding (p. 41).

We describe and illustrate some control equipment for machine tools (p. 42).

Our Questions and Answers page this week deals with the peculiarities of the readings of voltmeters used as earth detectors on three-phase systems (p. 43).

Among the subjects of specifications published by the Patent Office last Thursday were searchlight lamps, cord grips, wireless telegraphy, telephony, and phase advancers.—Two patents relating to helical filaments have been granted, in spite of opposition.—Patents relating to electrolytic manufacture of chlorates and electrical indication of the speed of ships expire this week, after a full life of 14 years (p. 45).

In a paper communicated to the Institution of Electrical Engineers and published in the *Journal*, Mr. F. C. Thompson gives the results of an investigation into the properties of German silver when subject to heat treatment (p. 45).

At the recent annual meeting of the B.E.A.M.A. an indication was given of the attitude of the Council towards the efforts which are being made elsewhere for co-operation in the engineering trade (p. 46).

Sub-station plant is required at Brighton; motors, switchboards, &c., by the Islington Guardians; a 3,000-kw. turbo-alternators, rotary converters, &c., at Wigan; and two 8,000-kw. turbo-alternator sets with condensing plant at Glasgow (p. 46).

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

(*To-day*) *Thurs., Feb. 3rd:* Shooting for Sections III. and IV.

Fri., Feb. 4th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Feb. 5th: Adjutant's instruction class at 2.30 p.m.

Sun., Feb. 6th: Trench work, train 9.33 Cannon Street.

Mon., Feb. 7th: Sections I. and II., technical. Sections III. and IV., lashings and trestle bridging. Signalling class and recruits.

Tues., Feb. 8th: School of arms, 6.0 to 7.0 p.m.

Thurs., Feb. 10th: Shooting for Sections I. and II., and signalling class.

Fri., Feb. 11th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Feb. 12th: Uniform parade, 2.45 *p.m.*

Sun. Feb. 13th: Signalling section. For particulars see Notice Board.

Appointments.—R. L. Matthews to be Corporal of Signalling Section.

Arrangements for the Week.—*Monday, Feb. 7th.*—I.E.E., Western Section, at South Wales Institute of Engineers, Park Place, Cardiff. "The Testing of Underground Cables with Continuous Current," by O. L. Record, 5.30 p.m.

Tuesday, Feb. 8th.—I.E.E., Manchester Section, at Engineers' Club, Albert Square. "The Testing of Underground Cables with Continuous Current," by O. L. Record, 7.30 p.m.—I.E.E., Scottish Section, at Princes Street Station Hotel, Edinburgh. "The Principles of Modern Printing Telegraphy," by H. H. Harrison, 8 p.m.

Wednesday, Feb. 9th.—Royal Society of Arts, John Street, Adelphi, W.C. "The Organisation of Scientific Research," by Professor J. A. Fleming, F.R.S., 4.30 p.m.

Thursday, Feb. 10th.—Institution of Electrical Engineers. "The Testing of Underground Cables with Continuous Current," by O. L. Record, 8 p.m.

THE FIRST ENGLISH HIGH TENSION D.C. RAILWAY

(*Concluded from p. 32.*)

THE sub-station switchgear has been supplied by the British Thomson-Houston Co., and is in two parts, one of the "cubicle" type controlling the high-tension feeder and transformer leads, and the other of the ordinary "flat-board" type controlling the rotaries, battery, booster, and live rail. Both portions are placed on the ground floor of the station. Each cubicle contains a hand-operated oil switch, the connections to the 'bus-bars being made through switch clips at the back. The apparatus is arranged so that the whole of it can be withdrawn from any one cubicle for inspection purposes, and is suitably protected with interlocking devices.

The rotary panels are two in number; one controls the live rails on one side of the station, and the other the live rails on the other side of the station. The up and down live rails in each case are independently controlled by a knife switch, but one circuit breaker governs both up and down live rails in one direction.

Transmission Line.—Two main feeder lines are used to convey the three-phase current from the generating station, which is at Clifton Junction: (1) the north line, four miles long, which runs from the power station to Radcliffe sub-station, *viâ* Ringley Road; (2) the south line, 4¾ miles long, which runs from the power station to the Manchester (Victoria) sub-station *viâ* Pendleton New. These two feeders are of the same size and each is duplicated. The north line is practically all overhead (7/10 S.W.G. copper), but some lengths of 3-core cable are used when passing under bridges. The south line consists of 1¼ miles of overhead of the same size, and 3½ miles of 3-core cable. The latter is in both cases 19/14, and is of Henley's manufacture. The overhead is carried throughout on "H" poles, the conductors being arranged three on each side of one pole, the other being left for future extensions. A standard span of 70 yards is employed. The "H" poles consist of two fir poles of an average diameter of 10 in. six feet from the butt. The cross arms supporting the insulators are of channel iron 4 in. by 2 in. by ½ in. clipped to the pole. The pole is also braced with wooden struts and bolts, but no anchor stays are used except at points where the line makes a bend. The cables are 3-core lead-covered and armoured, and are of Henley's make. They are carried on posts or wall-brackets. The cable armouring and also the ironwork on the poles are earthed to copper earthing plates, at quarter-mile intervals. No lightning arresters are used, but at the points where the cables enter the station and sub-station choking coils are provided.

Power Station.—As has been said, the length of the line which has been electrified up to the present is about 22 miles of single track, but as this is only the first stage of an important electrification scheme for the Manchester area, it was decided to provide a new power station of sufficient capacity in the first instance to serve the needs of the present requirements, and also to provide for considerable future extension. It has been built near Clifton Junction Station, a point 4¾ miles from Manchester on the main line between Manchester and Bolton. It is built on foundations which are everything that can be desired, and there is a good supply of water from the Manchester, Bury and Bolton Canal, owned by the railway company. The ground level at the power station is 37 ft. below the main line, and this enables coal wagons to be run directly over the tops of the coal bunkers, and renders coal-conveying appliances unnecessary.

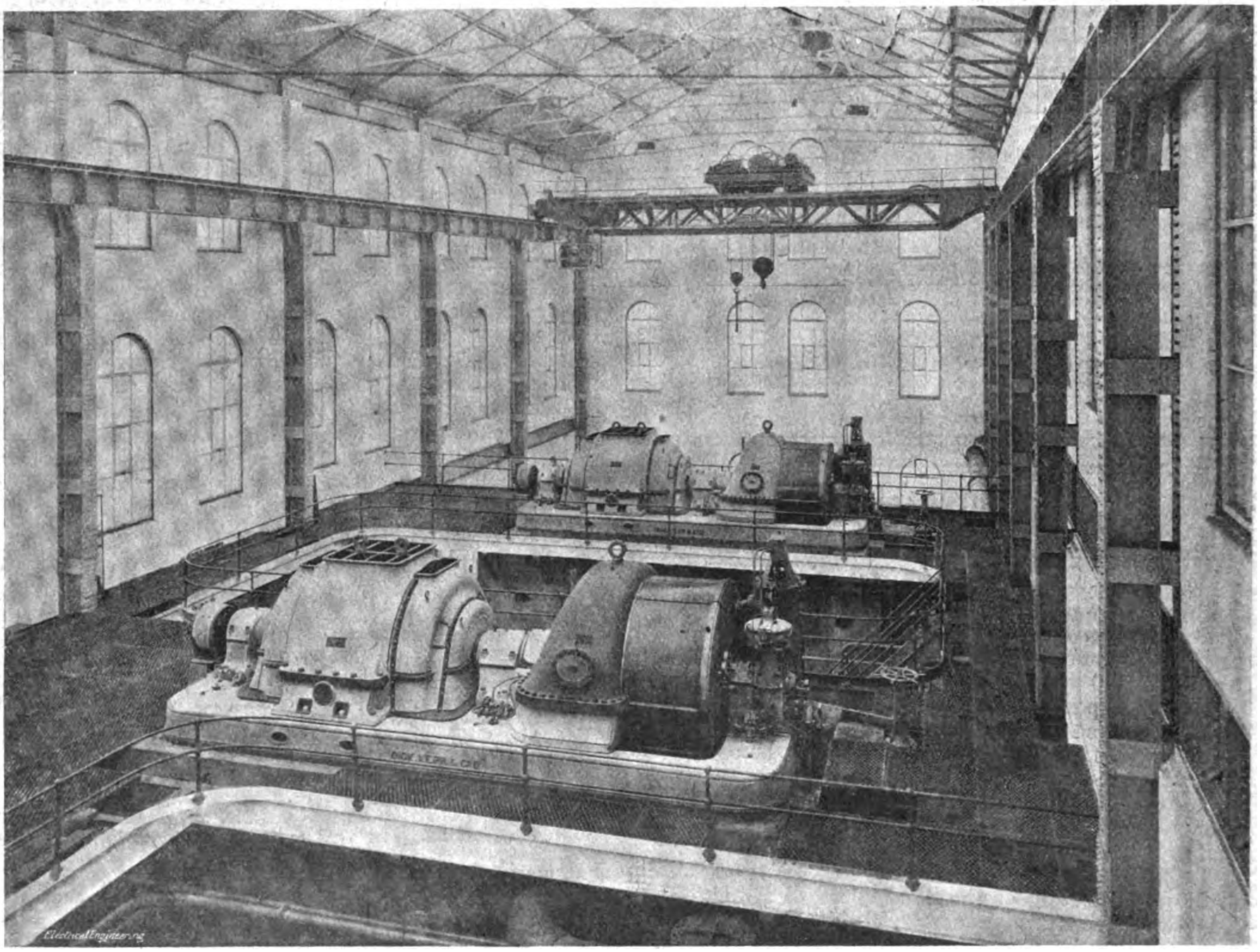


FIG. 5.—VIEW OF TURBINE ROOM.

The boiler room is 100 ft. long and 90 ft. wide, and is parallel with the turbine room. It contains three B. & W. water-tube boilers, each having a normal evaporation of 32,000 pounds of water per hour, from and at 212° F., the steam pressure being 200 lbs. per sq. in., superheated to 700° F. at the outlet. The boilers are fitted with B. & W. chain-grate stokers driven by three-phase 440-volt motors giving a speed variation to the grate of 6¼ to 25 ft. per hour. Green's economisers are used and have been placed above the boilers. There are induced draught fans, each capable of dealing with the products of combustion from two boilers when working together. These were manufactured by Messrs. Musgrave & Co., Belfast, and each is driven by a 40-h.p. 440-volt three-phase squirrel-cage motor at a speed of 360 r.p.m. The ash from the boilers is taken periodically by means of a Babcock & Wilcox suction ash conveyor to a large receiver, from which it is loaded into wagons at the main line level.

The coal bunkers are situated in the centre of the boiler room and are filled by means of bottom hopper wagons, the rail level being 37 ft., about the boiler room firing floor level. The hoppers

are constructed of mild steel plating, and hold 50 tons of coal without trimming. Corrugated steel sheet partitions separate the coal bunkers from the economisers.

The turbine room (Fig. 5) is 188 ft. by 64 ft. Its floor is of cast-iron non-slip grating, and suitable wells are arranged so that all auxiliaries in the basement, which is 20 ft. below, can be lifted directly by a 50-ton electric overhead crane, which has a span of 61 ft. and travels the whole length of the building.

Two main turbo-generator sets, by Messrs. Dick, Kerr & Co., each with a normal capacity of 5,000 kw., have been installed. The turbines are of the impulse type, having a Curtis wheel at the high-pressure end, the remainder being on the Rateau principle. The speed is 1,500 r.p.m. The alternators are two-pole machines generating 3-phase current at 6,600 volts 25 cycles, and each is capable of carrying 25 per cent. over-load for two hours and 50 per cent. over-load for five minutes. They are self-ventilated by means of fans fitted on the shaft at each end of the rotor. The air for ventilation is passed through Heenan & Froude wet-air filters, each of which can deal with 25,000 to 30,000 cubic feet of air per minute.

The condensing plant is manufactured by Messrs. W. H. Allen & Sons. The condensers are of the surface type capable of dealing with 82,000 pounds of steam per hour and of maintaining a vacuum of 28·1 in. at full load with cooling water at the rate of 6,700 gallons per minute at a temperature of 75° F.

An auxiliary turbo-generator forms an interesting part of the power station equipment, being a gear-driven machine supplied by the British Westinghouse Co. for driving the auxiliary apparatus. This set generates three-phase current at 440 volts 25 cycles. The turbine runs at 3,600 r.p.m., and the generator at 750 r.p.m., the reduction being obtained by gearing supplied by David Brown & Sons. The gear-wheel has a rim of a special high carbon steel, built up on a steel spider, and has 183 teeth. The pinion is made from solid nickel steel and has 38 teeth, with a pitch of teeth 0·597 in. and a face width of 21 in.

The station is at present equipped with two boiler feed pumps by Mather & Platt. One is a turbine pump and the other a reciprocating pump. Each is capable of delivering 10,000 gallons of feed water per hour, against a head of 217 lbs. per sq. in. The reciprocating pump is the only reciprocating machine in the station, and it is needed only as a stand-by.

The switchgear platform is arranged at the end of the station, and the switchboards are placed on a gallery overlooking the turbine room. There are three separate switchboards :—(1) The control board for operating the main units. This consists of thirteen panels, on which are mounted the necessary equipment for controlling the main switchgear for the two main generators, with two blank panels for future extension; there are also five feeder equipments, two transformer equipments, one test feeder equipment, and one synchronising equipment. (2) 440-volt A.C. switchboard for operating the station auxiliaries; this consists of five panels, on which are mounted hand-operated oil switches and the necessary gear for controlling two 250-kw. transformer equipments, one 500-kw. generator, two rotary converter equipments, and two feeder panels. (3) Continuous current board for controlling the control circuits, lighting, cranes, and stand-by batteries for the control circuits; this also consists of five panels, two controlling the D.C. side of the converters, one the 125-volt battery, and two feeder panels for the main control, lighting, and crane motors. The main switchgear, manufactured by the British Thomson-Houston Co., is solenoid-operated from the remote control, and is housed in a four-storey building; on the ground floor is housed the battery consisting of 70 cells. The first floor is the cable room, the second floor is the switch room, and the third floor the 'bus-bar room. The main switchgear is contained in cells built up of moulded stone, the phases being separated throughout with batteries of the same material. The 'bus-bars are in duplicate, and so arranged that any machine, or any set of feeders, can be connected to either set of bars, but no machine, or no particular set of feeders, can be connected to both sets at the same time. The voltage of the control current for the switchgear is 125.

With the switchgear a protective gear has been provided for the alternators and transformers, operated by means of current transformers and relays. Should a fault occur between phases or between any phase and earth, these relays operate and trip the main oil switch. Automatic field switches are also provided for the main turbo-alternators, which open the field circuit automatically when an internal fault occurs in the machine.

Slander Action.—Messrs. Bergtheil & Young, Ltd., sued Mr. R. H. N. Lindley, of Dalston, in the King's Bench Division last week for alleged slander. The complaint was that the defendant had used language to the effect that the plaintiffs' was a German firm. It was pointed out, however, that everything connected with the management of Bergthiel & Young was, and always has been, English, and in order to prevent any possibility of misunderstanding in the future, the consent of the Board of Trade has been given to a change in the company's name to Berkeley & Young. The defence was that the intention had been to ascertain whether the plaintiffs' was a German controlled firm, and that the explanation given had been accepted. In view of this the action was not proceeded with, the Judge remarking that there was no imputation on any of the parties concerned.

TRADE AND EMPLOYMENT AFTER THE WAR

On the initiative of the Lord Mayor of London, a very influential meeting was held at the Guildhall on Monday to discuss the questions relating to trade and employment after the war. A number of resolutions were passed, of which we give the most important below :—

That in the opinion of this meeting it is desirable that immediate steps be taken by His Majesty's Government and Chambers of Commerce and other kindred Associations throughout the country to formulate in close co-operation adequate action for the defence and improvement of trade and employment after the war, and with this object in view this meeting suggests full discussion of the fiscal, legislative, and voluntary efforts which ought to be made, and of the concentrated action and decisions which must be taken; and recommends the establishment of a Ministry of Commerce to carry out a constructive commercial policy for this country.

That steps be taken by means of close co-operation to improve the commercial relations between the United Kingdom, His Majesty's Dominions beyond the seas, and our Allies, and also to make certain that Germany and her Allies shall not be able again to acquire an undue influence upon trade and employment in the British Empire.

That the Lord Mayor's Organising Committee for this meeting be appointed to bring these resolutions before the Prime Minister by means of a deputation, and that the Committee (with power to add to their number) continue thereafter to urge their conclusions from time to time upon the Government.

During the course of the discussion the Lord Mayor of Birmingham (Alderman Neville Chamberlain) suggested that no scheme of this character could be regarded as complete without representatives of labour being included upon the proposed Committee, and this suggestion seemed to meet with general approval. On the whole, the proceedings indicated that the business men of London, and, indeed, all over the country, have at last determined to take steps to see that the Government really puts in hand the question of protecting our trade and commerce after the war from the German influences which have so largely dominated it in the past. The appointment of a Minister of Commerce was so emphatically demanded that no Cabinet could turn a deaf ear to the demands for the creation of this new post, but at the same time it was urged how essential it is that any such official should be not a party politician, but a business man who would remain in charge of the department whatever the political character of the Government in power at the moment. The work of the various committees that have been formed has shown that the attempts of the Germans to undermine British trade all over the world have been even more insidious than many people have suspected, and now that the Colonies have already passed resolutions which have the intention of preventing the dumping of German goods there after the war, it will be little short of suicidal on the part of British business men not to take some drastic action to ensure that the Government will look after their interests in a similar way. If the spirit of determination which animated the Guildhall meeting on Monday speaks for anything, it is that the patience of business men throughout the country in this matter is at last exhausted, and that the Government cannot any longer ignore the position, the full facts of which it is in complete possession. Having regard to the efforts which have been and are being made to bring about legislation which will safeguard the electrical industry from the baneful effects of foreign competition, this collective action of manufacturers and traders comes as exceptionally welcome, following as it does on the efforts which are being made by private interests to bring about some co-operation in the industry.

Obituary.—We have to announce the death of Mr. R. F. Venner, which occurred on January 24th. He was son of Col. Venner, of the Indian Army, and was born in 1861. In the early days of electric lighting he was on the staff of the International Health and Inventions Exhibitions at South Kensington, and a little later represented Shippey Bros. at the Antwerp Exhibition. In 1894 he took up the representation of Messrs. Chamberlain & Hookham with Mr. A. M. Sillar, and in 1896 the style of the firm was changed from Venner & Sillar to Venner & Co. on Mr. Sillar leaving to start consulting practice. Although Mr. Venner had been in bad health for several years, he continued to control the business, as well as that of the Venner Signs, Ltd., the sign with the spherical glass beads or marbles being his patent. During the last few years he interested himself in electrical cooking apparatus, and among his inventions in this direction was an electric griller or frying pan with oil circulation, which gave excellent results, but it has so far not appeared actively on the market.

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

BATTERY SIGNALLING BELLS

BATTERY signalling bells formed the subject of a discussion at a recent meeting of the Lancashire & Cheshire Branch of the Association of Mining Electrical Engineers at Manchester, reported in the *Iron and Coal Trades Review*. The discussion was initiated by Mr. G. M. Harvey, who submitted a Paper entitled "Notes on Experiments with Battery Signalling Bells following the Senghenydd Explosion," which comprised abstracts from the Home Office Report on the Senghenydd explosion, the official report by Dr. Wheeler on "Battery-bell Signalling Systems," and Dr. Thornton's Paper on "A New Battery Signalling Bell."

Mr. W. A. Heyes said that as far back as 1890 Professor S. P. Thompson had detailed the various methods for the suppression of sparking, and described devices similar to those Dr. Wheeler and Dr. Thornton suggested should be used to prevent sparking on the make and break of the electric current. He would mention a few of the methods with which experiments had been made.

Five straight electro-magnets were fitted with bobbins of the same size on the same iron core. The same current was used, and they had as nearly as possible the same weight of wire. No. 1 coil was wound in the ordinary way. No. 2 coil had a sheath of copper round the interior of the coil before any wire was put on, in accordance with the invention of the late C. F. Varley. No. 3 coil carried the principle of No. 2 still further in a way suggested by an American of the name of Paine, and revived of late years by Dr. Aron. That was to say, between each layer of the coil a sheet of metallic foil was interposed to kill the induction from layer to layer. No. 4 coil was wound differentially, having two coils so connected that when the currents went opposite ways there was no magnetism. If the circuit of either of the two wires was broken, the core at once became magnetised, and there was magnetism on breaking. The magnetism, on making the circuit, was destroyed, which was just the inverse to that of the ordinary electro-magnet. The spark occurred when magnetism disappeared, but in the former case, as the magnetism disappeared when the circuit was made, there was no spark to make because the circuit was already made; also, there was no spark at break, because at break there was no magnetism. No. 5 coil was wound according to a plan devised by Mr. Langdon Davies. The bobbin was wound with a number of separate coils in parallel with one another, each layer being a separate wire. The ends of all the layers were finally joined up. There were fifteen separate circuits, the time constant of them being different because, owing to the fact that the coils were of different diameters, the co-efficient of self-induction of the outer layers was rather less, and their resistance, because of their larger size, rather greater than those of the inner layers. The result was that instead of the extra current running out at the same time, it ran out at different times for the fifteen coils. The total electromotive force of self-induction never rose so high, and it was unable to jump a large air-gap or give the same bright spark as an ordinary electro-magnet.

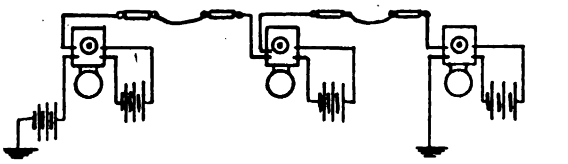


FIG. 1.—SINGLE LINE WIRE CLOSED CIRCUIT SYSTEM.

The order of merit of the above devices was as follows:—(1) The differentially-wound coil, which gave absolutely no spark; (2) the multiple wire winding; (3) the coil with the metallic foil between the layers; (4) the copper sheath. It would be seen, therefore, that over twenty-five years ago successful attempts were made to devise means to suppress sparking.

Mr. H. Green described a signalling system which he had invented some years ago. It worked on the closed-circuit principle, and only one live wire was needed, though signals could be given from any point. At each end of the haulage road a relay of high resistance was connected to the line, the remaining terminals of the relays being connected to earth, in one case through a battery (Fig. 1). At each of the relays a local battery and bell were connected. About every fifty yards along the haulage road an "interrupter" was connected in the line, which consisted of substantial contacts enclosed in a steel tube, which were normally kept closed. It would thus be seen that they had a complete circuit from the battery, through the first relay, along the line, through all the "interrupters" and the relay at the far end, to earth, and back to battery. The relay coils were thus kept normally energised and holding the armature away from its contact screw (Fig. 2). If the circuit was broken at any point, the relay armatures would be released, making contact and closing the local bell circuits. The line wire also served as a "pull-wire," and if it was pulled at any point the relay circuit would be broken at the nearest "interrupter." The minimum resistance of the circuit (neglecting the line) was 300 ohms—150 ohms for each relay. The line current did not, therefore, exceed 0·02 ampere, the battery giving 6 volts. There was no reason, of course, why more sensitive relays should not be used, wound for, say, 500 ohms each. That would bring the line current down to 0·006. Even under the first conditions, where the line current was 0·02, there was no sparking perceptible, and certainly no fear of igniting gas. Further, the sparking, if any, took place inside a steel tube, which could be perfectly gas-tight. The system eliminated altogether the chance of danger through sparking on the line. With regard to the bells, if the relay, bell, and local battery were all enclosed in a gas-tight case forming a complete unit, he thought it could be considered safe.

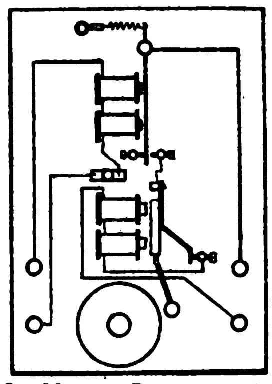


FIG. 2.—MINING BELL WITH RELAY.

UNUSUAL BREAKDOWNS

AT a meeting of the East Scotland Branch of the Association of Mining Electrical Engineers, on December 24th, Mr. Roger Devine read a Paper on some unusual breakdowns which had come under his personal notice. The following were specific cases referred to:—

(1) A breakdown occurred in connection with a large pumping set, consisting of a 200-h.p. 3,000-volt three-phase slip-ring induction motor driving a ram pump. The motor was controlled by an oil-immersed switch and a rotor switch of the liquid type. The pump and motor had been running well for about three months, when the writer was told the motor had suddenly stopped. The attendant said that there had been a heavy flash at the stator switch, and the lid of the trifurcating box of the outgoing cable had been blown off and the bitumen spattered over the wall. The switch on the panels at the surface had also tripped.

On opening up the switch it was found that a short-circuit was taking place between two of the trip coils which

were wound with enamel wire. The wires of the coils, which were about 1 in. apart, were found to be burned and pitted where the current had been arcing across. As it was essential that the pump should be started as soon as possible, and as it would take some considerable time to get a new switch installed, the writer tried putting a sheet of thick mica between the coils. This was done, and then the motor was started up and ran without a stop.

On taking the matter up with the makers, they stated that as the switch was tested with 6,000 volts before being immersed in oil, they could not see how it was now defective. When their representative arrived, the writer ran the motor without the mica, when the same thing occurred again, and it also did not recur when the mica was again inserted. The writer left the district before the matter was cleared up, but he was informed that the mica was still in the switch three months afterwards. There was no question of the motor or switch being overloaded.

(2) Another fault was on a 45-h.p. 3,000-volt squirrel-cage induction motor, driving at one end through a flexible coupling a centrifugal condenser pump, and at the other end an air pump by a rawhide pinion. The switching arrangements consisted of an auto-transformer starter with fuses on the running side only, and a main switch which controlled other three motors. The motor was found to be running excessively hot early one morning, and the writer was informed that the main switch had tripped the previous night. The ammeter on the main panel showed the current taken by the motor to be less than normal. An examination of the fuses showed that one was blown. The main switch and the auto-switch were also examined and found in good order. When a new fuse was put in, the motor worked quite satisfactorily.

(3) The next case was a fault which occurred in a 500-volt horizontal three-phase oil-immersed controller for a 50-h.p. open-type slip-ring motor. On the barrel of the controller there were three short pieces of ½-in. copper rod, completely covered with mica except for ½ in. at each end, and used for making connection between the incoming cables and the first step on the controller. One of the copper rods passed under the barrel contact of a different phase, but did not lie in direct contact with it. When in service, the whole barrel of the controller was completely immersed in oil. The rod which passed under the contact of an opposite phase was found to have the insulating cover of mica burned away to a length of 1 in., and the copper was also burned; so that there was a short-circuit between these two phases. This fault worked through all the high- and low-tension switches in the sub-station in the pit, and tripped the main switch in the power-house with unusual violence. It blew off a part of the cover of the trip coils of this switch, besides causing the needle of the ammeter of the switch in the power-house to go right over and stick there. The cover had to be taken off to put the needle back.

(4) Some time after that a fault took place on a 37/14 three-core armoured bitumen cable used as rotor leads for a 300-h.p. 3,000-volt motor. This was caused by the heat of the place softening the bitumen round the cores of the cable and causing a short-circuit. Immediately the switch was put on, and before the rotor-switch handle was touched, the local switch and the main switch tripped, but the incoming feeder switch did not trip. As there was no resistance in the rotor circuit, the rush of current through the stator must have been enormous.

Here we have two different cases of short-circuit, one on a primary circuit and one on a secondary circuit; one tripped the switch on the surface, while the fault on the 3,000-volt circuit only tripped the local and main switches. These switches were all properly set, and worked correctly at all other times, but the writer fails to see why the incoming feeder switch and the surface switch kept in in spite of the large current which must have been taken by the 3,000-volt motor.

(5) At another colliery there is a shaft exciter on the turbo-alternator, and on the exciting switchboard there are earth lamps to indicate a fault. Sometimes one of the lamps has burned more brightly than the other, this showing an earth on one side of the machine. This occurred two or three times a day, and went away again without anything being touched. To prove that there was a fault on the machine, the writer felt the brush-gear and got a distinct shock. When the machine was shut down the exciter armature, field coils, brush-gear, and leads to alternator slip rings were thoroughly tested with a megger, and a good test was obtained. All the cables were tested from the terminals of the machine back to the exciting switchboard and were found correct. The writer then examined the leads from slip rings of the alternator which pass under the soleplate. The rotor of the alternator was also tested and found clear. The test lamps were still showing an intermittent earth, and one of the fuses of the exciter was heating up rapidly. When the auxiliary steam exciter was tried, the fault still showed. It was then decided to replace the leads from the slip rings, and on doing so the leads were found to be saturated with oil. When replaced, the fault was cleared. As oil is supposed to be an insulator, it should not have caused an earth, but the fact remains that it did so. Since these leads were replaced there has never been an earth indicated by the lamps.

Electricity v. Steam for Shaft Winding.—A joint meeting of the Scottish branches of the Association of Mining Electrical Engineers and the National Association of Colliery Managers, together with the Mining Institute of Scotland, was held in the Royal Technical College, Glasgow, on January 22nd. Professor D. Burns read a Paper on "Electrical Shaft Winding," in the introduction to which he made some interesting remarks on the relative values of steam and electricity for shaft winding. So far as the question of reliability and ease of control was concerned, it was generally recognised that the electrical winder had now made good its case, and from that point of view could command attention. It was difficult to enumerate all the circumstances that might favour electricity, even where steam plants had already been installed at the colliery, but in general the wider application of central supply schemes and the electrical equipment of groups of mines must inevitably lead to a more extensive use of electrical winding. This development was readily foreseen, but it must be recognised that many large colliery concerns produce a large quantity of low grade fuel from their coal-cleaning processes, which was almost unmarketable, and had to be used for steam-raising purposes at the colliery in order to get rid of it. The necessity of thus having to dispose of the residue of the coal washer must, and probably always would, exert a powerful influence on the cost of steam raising, and would provide in many cases a factor in favour of steam winders which was entirely outside the merits of the two systems.

CONTROL EQUIPMENTS FOR MACHINE TOOLS

IT has long been recognised by manufacturers and users that to operate a machine tool at its highest efficiency there should be possible a wide variation in speed in each individual tool. To obtain the maximum efficiency it is not only necessary to adopt individual motor drive for each, but the control of the driving motor must be free from complication. It is advantageous that the motor control should be entirely automatic, requiring no attention from the operator beyond pressing the control button or throwing over the control arm, so that he can devote his whole attention to the work in hand. The automatic control should ensure that the motor starts, reverses, or stops in the shortest safe time when required, and that it is protected against excessive overloads at all times.

A series of fully automatic control equipments have been developed by the British Thomson-Houston Co. to meet these requirements. Four varieties are made, viz., non-reversing and reversing control with and without dynamic braking, but all equipments have a common feature in the accelerating unit, which is an automatic device giving full protection to the motor and ensuring that the machine starts or stops in the shortest safe time. The equipments are for constant-speed machines, but they can be used for variable-speed machines in conjunction with a field rheostat and a relay. Standard equipments are designed for capacities up to 10 h.p., and for voltages up to 550. Non-reversing control equipments without dynamic braking can also be supplied up to 15 h.p. at 200-250 volts, and up to 25 h.p. at 400/550 volts.

The operation is as follows:—When the control switch is closed, current flows through the motor armature, which is then in series with the full starting resistance and the first coil of the series contactor or accelerator, and the motor starts up slowly. As the speed increases the current taken from the line decreases, and when it reaches the value for which the accelerator is set, the first contactor closes and cuts out a section of the starting resistance. This results in a fresh current increment, and the operation is repeated by each contactor until the whole of the starting resistance is cut out and the motor is connected to the line. The accelerator is designed so that each section of the resistance is cut out in the shortest safe time, while the motor current is kept within safe limits. Each contactor switch is automatically locked open so long as the current flowing through its coil exceeds the value for which it is set. The motor is thus protected against excess current at each step of the accelerator. On moving the control switch to the "off" position, the motor is disconnected from the line and consequently comes to rest.

Where a quick stop is required, this is accomplished by means of a controller arranged for dynamic braking. When the handle of this controller is moved to the "braking" position, the connections are changed so that all the starting resistance is connected in series with the motor armature. The motor is then quickly brought to rest by dynamic braking, the contactor switches in this case acting as a retarding device and cutting out the resistance step by step as the speed of the motor decreases.

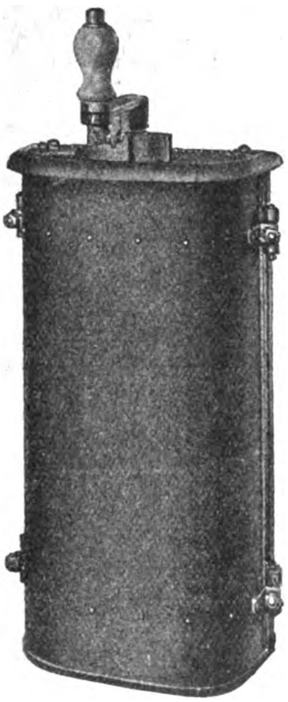
The accelerating unit consists of a number of series contactors or electrically-operated switches mounted on a slate base, behind which the starting resistance is mounted, the whole unit being totally enclosed in an iron box suitable for attaching to a wall. The whole device is extremely simple, due to the fact that the coil used for closing the contactor is also used to hold it open until the current has decreased to a safe value. The coil, being a series coil, is wound with wire or strip of ample section, so that it is not likely to be damaged by the instantaneous current rushes.

The controllers supplied for these equipments are three-way switches built in the form of drum-type controllers. For non-reversing control the three stops are for forward running or for braking positions; and in the case of reversing controllers with dynamic braking, these stops correspond to forward running, braking, and reverse running positions. For those without dynamic braking, the stops correspond to forward running, off, and reverse running positions. Controllers are fitted with magnetic blow-out coils, and are suitable for breaking the main current. The main switch fuse is of the double-pole quick-break type, enclosed in a cast-iron case.

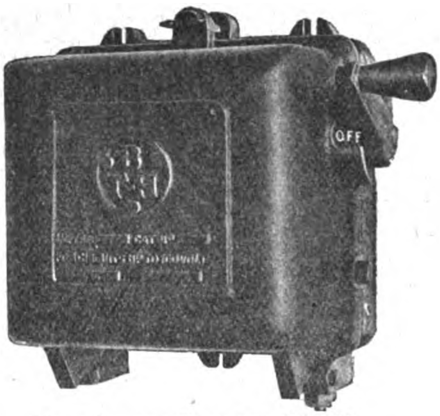
Equipments without dynamic braking can be supplied with push-button control, in which case the connections are specially arranged so that the results obtained on pressing any one button is maintained after releasing the button, and continues until a separate button is pressed. The contacts are mounted on a slate base and enclosed by a metal case through which the push-buttons project.

The relay supplied in connection with a hand-operated rheostat when speed regulation is required permits the motor to be stopped and then started again without the risk of starting on a weak field, and without the operator having to pay attention to the position of the rheostat handle. Thus when the field rheostat has been set for a certain cutting speed, the motor will automatically run up to that cutting speed when re-started after a stoppage.

The control equipment described above is giving satisfactory service, not only in the B.T.-H. Co.'s own works, but in many others throughout the world.

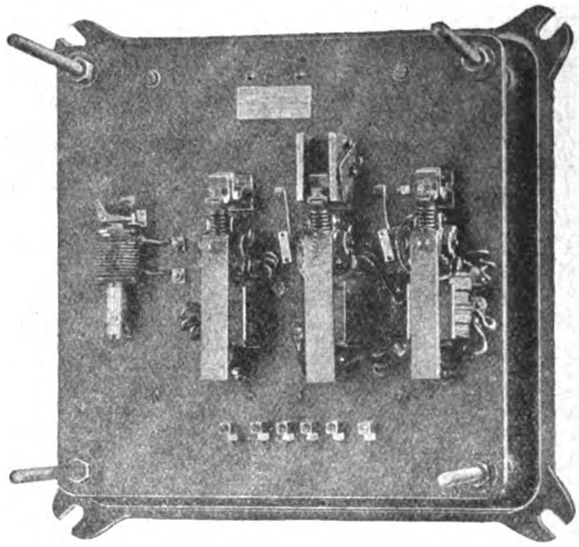


CONTROLLER FOR B.T.-H. MACHINE-TOOL CONTROL.



MAIN SWITCH FUSE FOR B.T.-H. MACHINE-TOOL CONTROL.

PUSH-BUTTON SWITCH FOR B.T.-H. MACHINE-TOOL CONTROL.



ACCELERATING UNIT FOR B.T.-H. MACHINE-TOOL CONTROL.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

QUESTION No. 1,480.

I have two 11-kw., petrol-driven, 220-volt D.C. dynamos that were originally shunt wound, but have been converted to compound winding.

The machine voltage (by adjusting regulator) is 220 when supplying 25 amps., and this drops to 200 when current is increased to 30 amps., the speed of the machine remaining the same.

By increasing the brush lead (which should give a greater field demagnetisation), the trouble is remedied a little on full load; but when running on no load the machine generates 250 volts with the regulator all in.

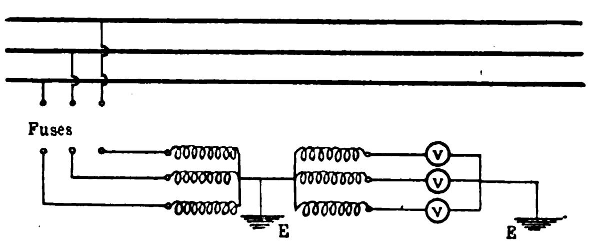
The machines cannot be paralleled as it is found the volts vary so much with the slightest change in current, so that the machines readily motor—first one and then the other—as the regulators are altered to endeavour to divide the load.

What is the cause of these difficulties, and how can they be remedied?—"BOOSTER."

(*Replies must be received not later than first post, Thursday, Feb. 10th.*)

ANSWERS TO No. 1,478.

In a three-phase system, 6,500 volts between phases, and neutral point insulated, three voltmeters are connected to the 'bus-bars through star-connected 3-phase potential transformers, as shown in the diagram, to act as earth detectors. The normal



readings are 3,800. On removing two of the three fuses readings were still obtained on all three instruments, as follows :—

Fuse A only in: A, 3,800; B, 2,800; C, 900.
Fuse B only in: A, 1900; B, 3,800; C, 1,900.
Fuse C only in: A, 900; B, 2,800; C, 3,800.

(1) Why was there any reading at all? (2) Why were the readings with fuse B only in different to those with fuses A or C only in? (3) Would there be a possibility of damage to the voltmeter by only having one fuse in?—E. B. P.

The first award (10s.) has been given to "X. Y. Z." for the following reply :—

Dealing with the three questions in order :—

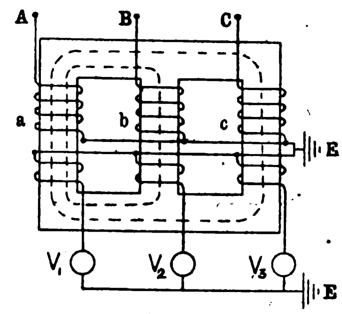
1. Why is there any reading at all? Simply because one end of the transformer winding is connected to one line and the other to earth, the return circuit being through the capacity of the lines to earth.

2. Why is the reading with fuse B in different from the others? When one fuse is in, the corresponding phase of the transformer gets its full voltage because the current it takes is not sufficient to upset the balance of the potentials of the lines to earth fixed by their capacities. The corresponding secondary, therefore, has full voltage, viz., 3,800, induced in it. Now the return path for the flux producing this voltage is through the cores of the other two phases in parallel. If fuse B is in—*i.e.*, the fuse corresponding to the middle phase of the transformer—the return paths through cores A and C are equal in length, and therefore the flux divides equally, half going each way, and thus inducing half-voltage, 1,900, in A and C. Now when fuse A is in, the return path for the flux is through cores B and C, but the path through C is longer than through B, and therefore more flux goes through the latter than the former. Thus a greater voltage is induced in B than in C. The sum of the voltages in B and C should equal that in A, which is approximately the case: 2,800+900=3,700. The odd hundred is easily accounted for by the fact that A.C. voltmeters are difficult to read with accuracy much below full reading. The opposite effect is produced with fuse C in—*i.e.*, the voltage in B is higher than in A.

3. Would there be any possibility of danger to the voltmeter by having only one fuse in? The values of transformer inductance and line capacity do not appear to be likely to produce resonance; therefore the worst that can happen is for the voltmeter to get $\sqrt{3}$ times its normal voltage, which will not do much damage. It may be mentioned, however, that at the moment of short-circuit dangerous pressure rises are likely to occur in any case, whether all fuses are in or out.

The second award (5s.) is made to "E. H." for the following reply, which we have abridged :—

In a three-phase star-connected system, with the neutral point insulated and with no fault on the cables, the condenser action between the conductors and earth causes the p.d. between each conductor and earth to be 0·58 of the line voltage. The capacity currents on a 6,500-volt system are quite appreciable, while the current taken by one of the transformers in question is very small in comparison, so



that its effect upon the p.d.'s between the line conductors and earth is negligible. It therefore follows that by inserting only one of the fuses the voltage across the corresponding primary is 3,800, and this reading must be registered on the voltmeter connected to its secondary.

The answer to the second part of the question will be evident from a consideration of the accompanying figure. Suppose fuse A only is in; then current flows from the corresponding line conductor through the primary of *a* to earth. Since the primary voltage is 3,800 (as explained above), the flux set up in the core of *a* must be the same as that produced when the three fuses are in place. In the present case, however, this flux is able to return either along the core of *b* or along that of *c*—as shown dotted. But the former affords a shorter path than the latter; consequently most of the flux returns *viâ b*. Since the E.M.F.s induced in the secondary windings depend upon the alternating flux linked with them, the reading on V_2 is greater than that on V_3; and if there were no leakage through the air, the sum of the readings on V_2 and V_3 would be equal to that on V_1.

When fuse B only is inserted, the flux set up in the core of *b* is exactly the same as that previously present in *a*. But this flux has two parallel paths of equal reluctance to return along, namely, the cores of *a* and *c*; hence the E.M.F.s induced in the secondaries of the latter are equal to each other. The values given in the question (1,900, 3,800, 1,900) seem to indicate that practically the whole of the flux returns by the iron cores. The true voltage corresponding to the reading 900 observed with fuses A and C may have really been nearer 1,000, since the lower part of the scale of an A.C. voltmeter is not generally very reliable.

When one of the conductors becomes "earthed," the voltage between either of the other conductors and earth is 6,500, and it can easily be shown that the voltmeter is not liable to damage with only one fuse in.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Jan. 27th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

24,335/14. **Search Lights.** G. A. Hughes. An improved projector lamp in which the arc is struck and controlled either automatically or by hand, the hand gear being stationary during automatic control. (Three figures.)

188/15. **Cord Grips.** C. Pressland. Lampholder cord grips having a leading-in cap with converging passages, annular rings or spigots being formed around the entrances to these passages between which and the lampholder body the wires are clamped, subsequently passing to the terminal cavities. (Six figures.)

398/15. **Wireless Telegraphy.** Signal Ges. A system of electric wave telegraphy by radiation below the surface of water in which waves of 3×10^8 per second frequency or more are employed, so that the dielectric A.C. resistance of the medium becomes equal to or less than the ohmic resistance.

580/15. **Telephony.** Relay Automatic Telephone Co. and W. Aitken. In manual or semi-automatic systems, a connection being made to the outgoing ends of a junction line, a signal is displayed at the incoming end thereof, and a B operator telephone is automatically connected thereto, means being provided for displaying as many signals as there are lines calling, and means for preventing more than one line being connected at one time with the B operator's telephone. (Two figures.)

1,802/15. **Phase Advancers.** G. Kapp. In phase advancers of the rotary type, the employment with each of the rotor phases of a machine the field of which is produced by current passing through separate field windings from each of the rotor phases and the armatures of which is in series with one of the rotor phases and the corresponding field winding. (Three figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Heating and Cooking: Berry and Markham [Electric fires] 2,546/15.

Instruments and Meters: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Meter magnets] 23,938/14; Burke [Excess meters] 270/15.

Switchgear, Fuses and Fittings: Mollett and Mollett [Shade holders] 482/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Electromagnetic switches] 4,911/15.

Telephony and Telegraphy: Pilkington [Microphones] 324/15; Sterling Telephone & Electric Co. and Ward-Miller [Wireless detectors] 1,091/15; Judd, Fraser & Eastern Telegraph Co. [Electrolytic current magnifiers] 11,314/15.

Traction: Shuttleworth and Shackleton [Electric transmission system for motor vehicles] 10,420/15.

Miscellaneous: Maitre & Martin [Electrical method of setting piano strings in vibration] 4,471/14; Stirk [Magnetic clutches] 24,659/14; Burdon (*Siemens & Halske A.G.*) [Röntgen tubes] 7,869/15.

The following Specification is open to Inspection at the Patent Office before Acceptance, but is not yet published for sale.

Dynamos, &c.: Martin [Dynamos] 18,137/15.

Amendment made

1,694/15. **Telephone Relays.** Western Electric Co. This specification, which deals with telephone relays or current amplifiers of the thermoionic type, has been amended by way of disclaimer.

Opposition to Grant of Patents

Grants of patents have been allowed on the following applications in spite of opposition :—

21,029/13 & 22,331/13. **Metal Filament Lamps.** C. O. Bastian. Lamps with tightly wound helical filaments of drawn wire. In the first it is specified that the convolutions are to be as near together as possible without actual contact, such as by less than half the diameter of the wire. In the second, means for doing this by coating the wire with a substance which is removed after coiling up is described.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years :—

2,987/02. **Electrochemistry.** R. Threlfall. An electrolytic method of preparing chlorates and perchlorates.

3,227/02. **Ships' Logs.** T. F. & T. S. Walker. Electric indicating and transmitting apparatus for logs for measuring the speed of ships.

The following are the more important patents that have become void through non-payment of renewal fees.

Dynamos, Motors and Transformers: H. C. E. Jacoby [A.C. commutator motors] 22,527/07; Brown, Boveri & Cie [Flywheel converters for load equalisation] 21,580/08; A. E. G. [Commutators] 21,761/08.

Heating and Cooking: G. Cooper [Heating apparatus] 21,493, 21,434, and 21,756/08.

Incandescent Lamps: H. Kuzel [Colloidal filaments] 25,443/08.

Telephony and Telegraphy: A. G. Rossi [Magnetic detector] 23,628/09.

Miscellaneous: L. W. P. Chetwynd, Kelvin & James White and F. W. Clark [Magnetic compasses] 21,634/08.

PROPERTIES OF GERMAN SILVER

Despite the great importance of the copper-zinc-nickel alloys, usually known in the electrical world as German silver, in the construction of resistances, definite data concerning the influence of composition and heat treatment have hitherto been lacking. A systematic investigation on the electrical resistances of the whole range of compositions employed in practice, and the exact effect of annealing the hard drawn wire of each alloy, has now been carried out by Mr. F. C. Thompson, whose results and conclusions are published in the *Journal* of the Institution of Electrical Engineers. These results show, amongst other things, that a hard-drawn wire made into a resistance, and then heated by current or otherwise to a temperature of about 300° C., may show on cooling an alteration of resistance amounting to over 8 per cent. In addition to this, there is a kind of critical range of annealing temperatures, from about 300° C. to 400° C., which gives very marked mechanical brittleness. This fact readily explains the deterioration of German silver resistances in course of time, especially when subject to vibration. It would thus appear advisable to utilise for the construction of electrical resistances only wires of German silver which have received a full annealing. The true annealing temperature, at which the extra hardness due to the wire drawing is removed, is often at least 200° C. higher than that at which the critical changes take place. When the wire has been fully annealed the changes do not recur.

AN EXCELLENT WINDOW DEVICE

We understand from the British Thomson-Houston Co., Ltd., that they have still available a few of the Mazda Revolving Lamp Shades which have been such an appreciated feature this lighting season. We show an illustration of this effective little advertising device, which comes to dealers packed in a neat flat packet containing all the necessary parts. Simple instructions are also enclosed to enable the window device to be erected. The shade proper rests on the tip of the Mazda lamp, the warm air from which, rising through the shade, operates an ingenious fan disc which causes the shade to revolve.

These interesting shades are obtainable on application by the trade to the British Thomson-Houston Co., Ltd., Publicity Department, Mazda House, 77 Upper Thames Street, London, E.C.

B.E.A.M.A. ANNUAL GENERAL MEETING

THE Annual General Meeting of the B.E.A.M.A. was held at the Connaught Rooms on Thursday, January 20th. Mr. F. R. Davenport (Willans & Robinson, Ltd.), Chairman of the Council, presided.

In submitting the annual report and balance sheet, the Chairman said that, notwithstanding the handicaps under which members were suffering, there was, compared with some other trades, no reason to be dissatisfied with the situation. Public attention was at the present time being largely directed to the question of the probable situation after the war, and several associations purporting to look after that matter and working more or less on parallel lines had sprung up. The B.E.A.M.A. had been invited to join some of these associations, but up to the present had not done so, though they had given considerable time to the exchange of views and the holding of conferences, and were still directing their attention to the efforts made towards creating some central and representative body which would embrace the common interests of all British traders. Suggestions had been made by the B.E.A.M.A. to the Colonial Office that money raised within the Empire should be expended on British goods, and whilst the Secretary of State for the Colonies was unable to give any definite assurance, there appeared now to be a far more favourable atmosphere surrounding the whole question of Colonial and Allied trade. The Association had been in conference with the Advisory Committee of the Commercial Intelligence Department of the Board of Trade, and many of the recommendations put forward, the Chairman understood, have been embodied in the report made by this Committee. The Association had also been in conference with the Government Research Committee, which was appointed by the Board of Education to inquire into the broad question of scientific and industrial research and for the granting of sums of money in aid of research.

With a view to organising and extending the export work of members, additions had been made to the export staff, and Overseas Committees had been appointed in India, Australia, and South Africa. Others, it was hoped, would be shortly appointed. Reference was then made to the *Beama Journal* as a publicity missionary for export trade and the series of informal evening gatherings which have been reported in our columns. Home conditions of contract and standardisation, continued the Chairman, still remained amongst their fundamental activities, and they had been actively engaged in these directions. He thought they might say that their position as an Association, both nationally as well as in relation to their own trade circles, had been strengthened without in any sense alienating, as far as he was aware, customers' minds and their general opinion of the B.E.A.M.A.

In the discussion which followed, Mr. Lundberg (A. P. Lundberg & Sons), Mr. Longbottom (Electromotors, Ltd.), and Mr. Berry (Berry, Skinner & Co.) referred to the unsatisfactory position in regard to patents. Practically all members, it was said, are now controlled firms, and their patents in a state of suspension, although patent fees have to be paid. This meant that the useful life of the patent would be shortened by the duration of the war. It was considered that, notwithstanding the unsympathetic attitude of the Board of Trade, the matter should be persevered with. The report was adopted.

Messrs. Callenders Cable & Construction Co., Ltd., were elected members of the Council.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Aberdeen.—Mr. J. A. Bell, the City Electrical Engineer, has reported upon a proposed sub-station at the harbour.

Glasgow.—The Electricity Committee has recommended that orders be placed for two 8,000-kw. turbo-alternator sets with condensing plant, one for the Port Dundas power-station and the other for St. Andrew's Cross. Completion of the orders is promised by September next. The estimated cost of this scheme is £54,000, and the proposal comes before the Town Council to-day.

London: *Islington.*—The adaptation of the present lighting and power installation at the Infirmary, Highgate Hill, in order to take supply from the Borough Council mains, is to be carried out. The work will be divided under three heads:—(1) Alteration to wiring, provision of switchboards and motor-starters, and erection of motors to be provided; (2) provision of single-phase A.C. motors; (3) purchase of existing plant. Tenders will be accepted for one or all sections. Further particulars from the consulting electrical engineer, Mr. W. C. C. Hawtayne, 9 Queen Street Place, E.C. Tenders by February 17th to the Clerk, St. John's Road, Upper Holloway.

Wigan.—A scheme for adding a 3,000-kw. turbo-alternator, surface condenser, two rotary converters, and water-tube boiler to the power-house at an estimated cost of £30,450 has been presented to the Council. It was pointed out that this was not due to the recent boiler trouble, but that the scheme had been under consideration for some time. There is a possibility that an independent expert will be called in to advise the scheme.

Miscellaneous

Australia.—The Sydney Council require six 11,000-volt submarine cables, each 400 yards long, for laying across Darling Harbour. City Electrical Engineer. April 10th. This information will only be of use to firms who can cable agents.

Belfast.—The Northern Counties Railway Committee (Ireland) require a six or twelve months' supply of electric lamps, carbons, &c. Secretary, York Road Terminus.

France.—According to the *Board of Trade Journal*, H.M. Consul at Lyons reports that a dealer in all kinds of electrical accessories there has considerable orders which he is unable to fulfil owing to shortage of local supplies, and desires to get into communication with United Kingdom manufacturers. Further information at 73 Basinghall Street, E.C.

Manchester.—The Tramways Department requires various stores, including lamps, telephone material, overhead equipment, motor and controller parts, resistances, &c. General Manager. February 15th. (See advertisement on another page.)

Sheffield.—The Health Committee requires a twelve months' supply of various stores, including electrical fittings, &c. Superintendent, Cleansing Department, Town Hall. February 12th.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £122 to £126 (last week, £118 to £122).

Venner & Co.—In reference to the death of Mr. Venner, mentioned on another page of this issue, we are asked to state that Mr. Ernest E. Sharp, the manager of Venner & Co., will be running the affairs of the Company at 6 Old Queen Street, Westminster, S.W., as before, and that Venner Signs, Ltd., is also continuing at the same address under Mr. Battson.

APPOINTMENTS AND PERSONAL NOTES

At the meeting of the Manchester Section of the Institution of Electrical Engineers last week, Mr. C. P. Sparks, the President of the Institution, mentioned that he has three sons and a brother at the front, and that his youngest son has been appointed Aide-de-Camp to Sir Herbert Plumer, a member of the General Headquarters Staff.

Mr. L. W. Phillips, late of the technical staff of the Edison & Swan Laboratory, Ponders End, has been appointed Manager of the Advertising & Publicity Department of the Electrical Supplies Company, "The Light House," 233 Tottenham Court Road, London, W.

Mining Patents of January.—In Specification No. 3,710 of 1915 J. G. Patterson describes an improved form of charging-rack for the batteries of electric miners' lamps. Each cell stands on an acid-proof insulating base so shaped that the cell can easily be pushed in to make contact with the connections and to retain any liquid that may escape from the cell.

The Institution and Enemy Members.—With reference to the recent notification from the Institution of Electrical Engineers as to alien enemy members (ELECTRICAL ENGINEERING, Jan. 22nd, page 22), we have reason to believe that the Council now intends to take some definite action in the matter.

ELECTRICAL ENGINEERING

With which is Incorporated

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SUMMARY

We publish a list of those members of the Institution of Electrical Engineers who have been rewarded for services in the field, and also a further list of those now serving with the Forces (p. 48).

A report to the Board of Trade by their Electrical Adviser, dealing with the Eastbourne accident, in which a motor-car collided with a street pillar, contains some general recommendations as to the use of electric pillar boxes in streets (p. 48).

We abstract the important report of the Sub-Committee of the Advisory Committee of the Board of Trade in respect to measures for securing the position after the war of certain branches of British industry. The B.E.A.M.A. has played an important part in the deliberations of this Committee, many of their recommendations being favourably reported upon. The most important points, perhaps, in the report are the suggestions that import duties should be favourably considered by the Government, and that a Minister of Commerce should be appointed (p. 49).

The Institution *Journal* of Feb. 1st contains a useful contribution from Mr. A. P. Trotter on "A Set of Proposed Standard Numerals for the Scales of Measuring Instruments" (p. 49).

A new form of enclosed starter for continuous current motors is being placed on the market by the British Thomson-Houston Co., Ltd., Rugby (p. 50).

The Institution of Electrical Engineers has at last decided upon the expulsion of enemy members (p. 50).

Among the subjects of specifications published at the Patent Office last Thursday were microphones, wireless receivers, electric fires, and cable relays. A patent for testing elements is opposed. A patent for an alloy for transformer cores, &c., expires this week, after a full life of fourteen years (p. 51).

Our Questions and Answers page this week describes simple methods of testing switch and transformer oils (p. 51).

Mr. P. W. D'Alton, who was called in by the Dublin Corporation to report upon the position of the electricity undertaking, has made some strong comments.—The Local Government Board has sanctioned the expenditure of £83,000 upon plant for the Stuart Street power station, which plant will eventually be transferred to the Barton power-house.—An action for alleged slander is pending between a member of the Dublin Electricity Department staff and the City Electrical Engineer (p. 53).

Mains, transformers, and switchgear are required at Woolwich, switchgear and transformers at Stoke-on-Trent, and plant at St. Pancras and Pembroke.—Stores are required in a number of towns (p. 54).

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

(To-day) Thurs., Feb. 10th: Shooting for Sections I. and II., and signalling class.

Fri., Feb. 11th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Feb. 12th: Uniform parade, **2.45** ***p.m.***

Sun., Feb. 13th: Signalling section.

Mon., Feb. 14th: Sections I. and II., technical. Sections III. and IV., lashings and trestle bridging. Signalling class and recruits.

Tues., Feb. 15th: School of arms, 6.0 to 7.0 p.m.

Thurs., Feb. 17th: Shooting for Sections III. and IV.

Fri., Feb. 18th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Feb. 19th: Adjutant's instruction class at 2.30 p.m.

Sections for technical parade at Headquarters, London, Electrical Engineers, 46 Regent Street, S.W. Sections for shooting parade at miniature ranges. Unless otherwise ordered, all parades at Chester House.

L.C.C. and Electric Lighting Acts.—The Highways Committee was instructed in November to report whether steps could be taken to ensure that the whole cost of the work carried out by the London County Council under the Electric Lighting Acts should be covered by the fees received. This work comprises the testing of meters, the testing of pressure on the various distributing net works, work connected with notices of intention to lay mains, service lines, &c., and the inspection of the consequent work in the streets to see that the conditions imposed by the Council are complied with. In 1914–15 the expenditure exceeded the receipts by £596, but after a careful consideration of the circumstances, the Committee recommend that no alteration should be made with regard to increase of fees. The cost of pressure testing is borne by the electric lighting authorities, and therefore it is only by an increase of the fees for meter testing that the receipts could be increased. A revised scale was brought into operation with the approval of the Board of Trade in 1913.

(For "Arrangements for the Week" see p. 54.)

THE INSTITUTION AND THE FORCES

THE following rewards for service in the field to members of the Institution of Electrical Engineers are notified in the *Journal* for February 1st :—

Victoria Cross.—Lieut.-Com. E. G. Robinson, R.N.

Companion of the Bath.—Lieut.-Col. J. C Chambers, West Riding Divisional A.S.C.; Brig.-General A. M. Stuart, Director of Works.

Distinguished Service Order.—Major F. J. Chapple, North Midland R.G.A.; Major S. H. Cowan, R.E.; Capt. A. E. Davidson, R.E.; Capt. H. M. Leaf, R.M.L.I.

Military Cross.—2nd Lieut. C. H. Goulden, R.G.A.; Lieut. H. R. L. Groom, Royal Warwickshire Regt.; Lieut. H. J. Gwyther, Manchester Regt.; Capt. H. P. T. Lefroy, R.E.; Lieut. I. W. Massie, R.E.; Lieut. A. Podmore, R.E.; 2nd Lieut. O. W. Sherwell, R.F.A.; Lieut. A. R. Tabor, R.F.A.; 2nd Lieut. G. W. Williamson, 3rd Manchester Regt.

Distinguished Service Cross.—Lieut. E. G. Boissier, R.N.D.

Distinguished Conduct Medal.—Private A. M. Doig, 1/6th Manchester Regt.; Private P. J. Wood, 18th London Regt.; Corporal C. W. Saunders, New Zealand Engineers.

Distinguished Service Medal.—Sapper J. H. Murray, Divisional Engineers, R.N.D.

Mentioned in Dispatches.—Lieut. C. R. Bicknell, R.G.A.; Capt. W. Casson, London Regt.; Commander W. H. Cottrell, R.N.V.R.; Sapper E. L. Damant, Divisional Engineers, R.N.D.; Lieut. H. L. Downes, Liverpool Regt.; Lieut. C. H. W. Edmonds, R.E.; Petty Officer C. S. Hann, Hawke Batt., R.N.D.; Lieut. L. V. Hart, R.E.; Major F. A. Iles, R.E.; Major G. S. Knox, R.E.; Capt. H. P. T. Lefroy, R.E.; Capt. G. T. W. Olver, R.E.; Capt. T. V. Smith, R.F.C.; Major G. H. Spittle, Divisional Engineers, R.N.D.; Brig.-General A. M. Stuart, C.B., Director of Works; Lieut. H. R. Tuppen, A.S.C.; 2nd Lieut. R. A. Williams, R.E.

The following additional list of members of the Institution of Electrical Engineers serving with H.M. Forces includes also promotions, transfers, &c. We have already given the full list of the members serving in ELECTRICAL ENGINEERING for January 21st, February 18th, March 4th, and July 15th, 1915, and January 6th, 1916.

Members.—Lieut. W. L. Carter, R.E.; Capt. S. V. Clirehugh, A.S.C.; Lieut. H. T. Harrison, R.N.V.R.; Capt. H. M. Leaf, R.M.L.I.; Capt. W. H. U. Marshall, Dorset (Fortress) R.E.; Lieut.-Col. R. E. P. Piggott, Suffolk Regt.; Lieut. N. W. Prangnell, R.N.V.R.; Capt. F. O. J. Roose, R.G.A.; Major J. Wayne-Morgan, Glamorgan (Fortress) R.E.; Major H. O. Wraith, R.E.

Associate Members.—Bt. Major B. C. Battye, R.E. (for service in the field); Lieut. H. K. Benson, Glamorgan (Fortress) R.E.; 2nd Lieut. A. Whitten Brown, R.F.C.; 2nd Lieut. G. J. L. Brown, Lowland R.G.A.; Capt. W. F. Brown, R.E.; Major F. J. Chapple, North Midland R.G.A.; Capt. F. C. Clarke, London Elec. Eng., R.E.; Lieut. H. Clausen, R.N.V.R.; Capt. H. A. Cope, London Elec. Eng., R.E.; Capt. W. P. Digby, London Elec. Eng., R.E.; Capt. J. W. Dodds, Northern Cyclist Batt.; Lieut. P. Dunsheath, R.E.; Farrier-Sergt. The Hon. E. Fulke French, Divisional Engineers, R.N.D.; 2nd Lieut. J. S. Gibson, 9th Bedford Regt.; Lance-Corpl. C. L. Goolding, London Elec. Eng., R.E.; Capt. E. E. Grover, 14th Northumberland Fusiliers; P.O. C. S. Hann, Hawke Batt., R.N.D.; Major N. Harrison, S.A. Engineers, Overseas Force; Capt. H. F. Haworth, London Elec. Eng., R.E.; 2nd Lieut. F. R. Hoggett, 10th West Surrey Regt.; Capt. H. N. Holland, A.S.C.; Capt. E. B. Hunter, London Elec. Eng., R.E.; Qmr.-Sergt. J. C. Hutton, 6th Staffs Regt.; 2nd Lieut. J. G. Jones, 29th Royal Fusiliers; Lieut. H. McK. Kirkby, A.O.D.; 2nd Lieut. W. C. C. Langdon, R.G.A.; Lieut. D. S. Laurie, R.E.; 2nd Lieut. R. C. Leslie, K.O.S.B.; 2nd Lieut. R. F. Long, R.F.A.; 2nd Lieut. A. J. P. McCarthy, R.E.; Trooper T. S. L. Mann, Westminster Dragoons; Lieut. S. Mathews, London Elec. Eng., R.E.; Major W. H. Merrett, London Elec. Eng., R.E.; Lieut. N. Miller, Divisional Engineers, R.N.D.; Lieut. R. C. Milliken, London Elec. Eng., R.E.; Capt. G. C. Milnes, 5th Royal Lancaster Regt.; 2nd Lieut. B. J. Moore, R.F.C.; Capt. H. E. Morrow, Divisional Engineers, R.N.D.; 2nd Lieut. A. M. Mulliner, 9th West Surrey Regt.; Lieut. G. Paton, A.O.D.; Lieut. B. H. Peter, R.E.; Capt. A. R. Z. Porter, Queen's Westminster Rifles; 2nd Lieut. E. B. C. Preston, 57th Wilde's Rifles; 2nd Corpl. H. K. Reed, London Elec. Eng., R.E.; Major T. Rich, London Elec. Eng., R.E.; Capt. A. M. Robertson, Dundee (Fortress) R.E.; 2nd Lieut. H. Robertson, R.F.A. (T.F.); Commander E. G. Robinson, R.N. (for service in the field); Warrant Officer W. R. Rogers, R.N.; 2nd Lieut. H. R. Sanders, 25th London Regt.; Capt. D. H. Slack, Kent (Fortress) R.E.; Capt. A. P. Smith, 4th Argyll and Sutherland Highlanders; Lieut. B. H. Smith, Divisional Engineers, R.N.D.; Capt. T. V. Smith, R.F.C.; 2nd Lieut. H. D. Staniar, R.E.; 2nd Lieut. W. D. Stewart, R.E.; Lieut. E. J. Stiell, R.E.; Lieut. G. Sykes, R.N.A.S.; Sergeant W. A. Talbot, Divisional Engineers, R.N.D.; Lieut. C. A. Tayler, A.O.D.; Capt. H. de C. Toogood, R.E.; 2nd Lieut. H. E. Turner, East Riding R.G.A.; Lieut. F. R. Unwin, 1st London Divisional R.E.; Major C. E. Vines, R.G.A.; Lieut. A. G. Watson, Divisional Engineers, R.N.D.; Major H. E. Webb-Bowen, London Elec. Eng., R.E.; 2nd Lieut. E. Williams, 3/1st London Divisional R.E.; Lieut. J. L. Wilson, East Lancashire R.E.; Capt. W. S. Wilson, Durham (Fortress) R.E.; Capt. A. L. Wood, 15th Lancashire Fusiliers; 2nd Lieut. E. L. Wood, 2/7th Gordon Highlanders.

Associate.—Capt. R. W. Hughman, 9th Middlesex Regt.

Graduates.—Capt. T. D. B. Bowater, Westminster Dragoons; 2nd Lieut. E. G. Bowers, 11th Northumberland Fusiliers; 2nd Lieut. F. E. Burnett, East Riding R.E.; Sergt. F. L. Cater, A.S.C.; 2nd Lieut. P. Grice, North Staffordshire Regt.; Lieut. R. E. Hume-Williams, A.S.C.; 2nd Lieut. B. J. Leggett, R.E.; Lieut. R. E. L. Owen, R.G.A.; Major E. A. Pells, 1st London Divisional R.E.; Capt. G. H. N. Reay, R.E.

Students.—Lieut. H. G. Baker, 3/4th Gloucestershire Regt.; Corpl. L. W. E. Baxendell, Divisional Engineers, R.N.D.; 2nd Lieut. H. G. Bell, R.E.; Lieut. C. R. Bicknell, R.G.A.; Lieut. C. H. Brazel, R.E.; 2nd Lieut. L. Broadwood, R.E.; 2nd Lieut. N. B. Bunt, R.E.; 2nd Lieut. G. D. Canton, A.S.C.; 2nd Lieut. E. L. Chadwick, 7th Royal Warwickshire Regt.; Flight Sub-Lieut. G. G. Dawson, R.N.A.S.; 2nd Lieut. T. A. F. Dixon, R.E.; 2nd Lieut. E. Edminson, 10th North Staffordshire Regt.; Private A. H. Finnis, 25th Royal Fusiliers; 2nd Lieut. J. M. Furnival, R.F.C.; Corpl. F. Goble, London Elec. Eng., R.E.; Lieut. T. H. Hall, R.G.A.; Lieut. F. H. Hayward, R.N.V.R.; 2nd Lieut. C. G. Huntley, Tyne Elec. Eng., R.E.; Lieut. Forbes Jackson, Divisional Engineers, R.N.D.; 2nd Lieut. H. Y. V. Jackson, R.E.; 2nd Lieut. J. W. Kilby, Kent (Fortress) R.E.; 2nd Lieut. L. A. McDougald R.F.C.; 2nd Lieut: C. E. Maguire, Royal Anglesey R.E.; Lieut. R. Marx, R.F.A.; 2nd Lieut. B. S. Orme, Wessex Divisional R.E.; Lieut. A. C. Pallot, Hampshire (Fortress) R.E.; Capt. G. R. D. Prince, Kent (Fortress) R.E.; 2nd Lieut. E. L. M. Protheroe, R.F.A.; 2nd Lieut. R. N. L. Protheroe, R.F.A.; 2nd Lieut. W. A. Reeves, 9th East Surrey Regt.; 2nd Lieut. H. Riley, R.E.; 2nd Lieut. J. T. Rodwell, R.F.C.; Lance-Corpl. C. W. C. Sadler, R.E.; 2nd Lieut. A. M. Searle, R.E.; 2nd Lieut. C. G. Shaw, 2nd London Divisional R.E.; Lieut. O. W. Sherwell, R.F.A.; 2nd Lieut. E. J. Shuter, Royal Marines; Sapper T. H. Solomon, Divisional Engineers, R.N.D.; Lieut. C. D. Stoneham, R.E.; Lieut. D. G. Trouton, R.F.A.; 2nd Lieut. T. P. Wilson, A.S.C.; Capt. T. G. Woolley, R.E.

THE EASTBOURNE ACCIDENT

Board of Trade on Electric Pillar Boxes

ARISING out of the fatal accident at Eastbourne, reported in our issues of December 30th and January 13th, when two men were killed by shocks from a motor-car which had collided with a street pillar, a Report has been made to the Board of Trade by their Electrical Adviser, Mr. A. P. Trotter, who makes some general observations and recommendations as to the use of pillar-boxes. The Report states that pillar-boxes of a kind similar to the one which was destroyed at Eastbourne have previously been broken by collisions with vehicles, and in view of the increased speed and weight of street vehicles, further attention should be given to the use of such electric pillars in the streets. The following "recommendations as to electric pillar-boxes for use with high-pressure supply" are made :—

1. The suggestion made by the Coroner's jury that pillar-boxes should be placed further away from the side of the road is good. It is better to place them in side-streets than in main thoroughfares. If possible, they should be built into the walls of houses or gardens. Local authorities should use their influence to obtain accommodation for such boxes on reasonable terms.
2. Where pillars can be moved back from the curb by moving the cables without entailing undue expense in cutting and re-jointing, this is desirable.
3. A curb not less than 6 in. high extending not less than 10 ft. on each side of the pillar is desirable.
4. Where pillars are set near a curb, fenders or "spurs" of rounded blocks of stone or of strong iron castings could usefully be set at the corners of pillars facing the road. A door opening on to the street must be shaped to clear them.
5. Cast-iron pillars should be reinforced by a cage of wrought-iron rods incorporated in or attached to the cast-iron, which will tend to hold the fragments together in case of destruction, or an inner lining of sheet or of expanded metal or wire mesh should be attached to the pillar and to the doors, and the pillar should be connected to a substantial earthplate as well as to the lead of the cables.
6. Loose "tails" of rubber-covered wires are highly objectionable, and should be avoided by enclosing them in a metal tube carefully earthed, and filled in solid with compound.
7. It is not desirable that transformers should be placed in pillars above ground, unless loose wires and cables and exposed live parts can be altogether avoided. Where street boxes are used as transformer chambers they should be placed below ground, and properly-designed switch-pillars may be set over them, or, preferably, they may be built into a wall.
8. The foregoing recommendations may be applied also to low- and medium-pressure pillars.

BRITISH TRADE AFTER THE WAR

THE report of the Sub-Committee of the Advisory Committee to the Board of Trade with respect to measures for securing the position after the war of certain branches of British industries, is naturally of considerable interest in its general aspects, and specially so by reason of the importance attached to the various suggestions made by the British Electrical & Allied Manufacturers' Association. The Committee directed its attention to thirteen British industries, of which one referred to electrical apparatus generally and another to magnetos. Indirectly, too, the electrical industry is interested in the china and earthenware trades, which were also included.

It is pointed out that in 1913 the total value of imports into Great Britain of electrical goods and apparatus other than machinery and uninsulated wire amounted to £12,856,000, of which £5,907,000 came from Germany and £486,000 from Austria-Hungary. The imports of telegraph and telephone apparatus amounted to £252,000, but these were chiefly from Belgium and Sweden, only £39,000 coming from Germany, and nothing from Austria. On the other hand, of the total imports of electric glow lamps, namely, £196,000, no less than £156,000 came from Germany and £6,000 from Austria-Hungary; whilst of the £115,000 of "parts of electric lamps," £97,000 came from Germany. The total imports of electrical machinery, which, however, does not come within the Committee's report, was, for 1913, £1,346,000, of which £721,000 came from Germany.* The manufacture of magnetos, of course, has developed into almost a German monopoly, and of the £500,000 of imports no less than £475,000 came from Germany.

Among the matters upon which very emphatic opinions were placed before the Committee were the need for greater Government assistance in industrial scientific research, but it is pointed out in this connection that under the scheme of State aid recently established by the Privy Council, first grants are now being made.

In connection with patents, the B.E.A.M.A. made the following proposals :—

(1) That three classes of patent protection be created :—

(a) A short term or petty patent for improvements or modifications in design, without provisional protection, and at a low cost.

(b) A long term patent for new inventions, the period of provisional protection being twelve months, and the full period to be at least fifteen years, with an option to extend it to twenty-one years by payment of increased fees.

(c) A patent for discovery of new principles, the patentees to be permitted to claim reasonable royalties from patentees of apparatus making use of such principles.

(2) That an attempt be made to bring about the unification of the British Empire.

Although the Committee feel that the first proposal calls for detailed consideration, it recommends that efforts to secure uniformity of patent law throughout the Empire should be continued; that the law as to compulsory working be more vigorously enforced; and that the fullest possible information as to enemy patents should be given to British firms during the war.

In another and more important direction the B.E.A.M.A. put forward suggestions to which the Committee draws special attention, namely :—

(i) That the Board of Trade should, as soon as possible, call together a conference of representatives of shipowners, railway companies, and the manufacturing industries, to discuss the whole question with a view to co-operation in removing the existing handicaps under which British industries labour when in competition with foreign producers; and

(ii) That an Imperial tribunal of the Government be set up to exercise the functions of a tribunal for adjusting grievances existing between railway and transport companies and traders, more especially where it can be shown that the foreigner is benefiting at the expense of British industry.

The Committee recommend that an impartial tribunal should be set up to secure that no preference is accorded to foreign traders over British traders by British shipping companies or railway companies, and that shipping companies should be prohibited from charging higher rates of freight from British ports than from any North European ports. We called attention in our issue for January 27th to an article in the B.E.A.M.A. January *Journal*, which gave some striking facts on this point.

The B.E.A.M.A. was again to the fore in suggestions as to financial assistance by way of industrial trust companies and the conditions to be attached to loans to foreign countries. The number of cases in which foreign contracts have been lost to British industry solely because German banks have come to the assistance of German manufacturers are too well known to need repetition, but the present is the first real opportunity upon which the electrical industry has been able to drive home the importance of the point upon the Government. Therefore the following recommendations of the Committee in this connection have special significance :—

Financial Assistance.—(a) The Joint Stock Banks should be invited by his Majesty's Government, as soon as opportunity offers, to consider the possibility of affording a greater measure of assistance to British industrial enterprise.

(b) All Government Departments, Local Authorities, and Statutory Bodies entrusted with the control of monies by taxes or rates, should be under legal obligation to purchase, so far as possible, only goods produced within the British Empire.

To meet exceptional cases, the Board of Trade might be empowered to grant licences to Public Bodies for the purchase of foreign goods where special circumstances, including, for example, the existence of a combine or "trust" can be proved.

(c) British financial houses concerned in the issue of foreign loans in the United Kingdom should be urged to endeavour to secure that preferential treatment be accorded to British contractors and manufacturers in respect of the public works to be carried out by means of such loans.

In the evidence placed before the Committee there seems to have been some doubts cast upon the business value of ordinary exhibitions, and greater importance was attached to the continuance, and even extension, of Board of Trade fairs. The B.E.A.M.A. represented that, in their opinion, the expenditure of Government money on British participation in recent international exhibitions abroad has not greatly benefited British industry, since such exhibitions have generally been in countries which impose high import duties on British goods, and they suggested that consideration be given to the promotion of trade exhibitions in British Dominions and Colonies and in countries where the conditions are favourable to British enterprise. The Committee enunciate the particular principles which they think should be adopted in respect of future trade exhibitions, and these fit in with the views placed before it.

The establishment of a Ministry of Commerce is recommended, and reference is made to the B.E.A.M.A.'s suggestion that the decimal coinage and metric system should be adopted, but the Committee make no recommendation upon this.

Finally comes the question of some form of tariff protection for the industries investigated by the Committee. Special mention is made of the magneto industry, representatives of which asked for an undertaking that the Government Department concerned in motor transport and air services should undertake to use only British magnetos, and that the import duty of 33⅓ per cent. imposed upon magnetos imported as parts of motor-cars should be applied to magnetos imported separately from motor-cars. The Committee make no definite recommendations as to the exact limits of such import taxation, but report that as there is a strong desire to respond to the feeling in the Dominions of an Imperial preference in trade, and also for preferential trading with our Allies, it will be necessary to impose some widely-spread import duties; and that, in view of the threatened dumping of stocks which may be accumulated in enemy countries, the Government should take steps to prevent industries likely to be affected being endangered.

* A detailed analysis of Germany's total electrical exports (amounting to £14,500,000) to this and other countries will be found in ELECTRICAL ENGINEERING of August 13, 1914.

Standard Numerals for Measuring Instruments.—In the *Journal* of the Institution of Electrical Engineers of Feb. 1st, there is published a Paper by Mr. A. P. Trotter, on "A set of proposed standard numerals for the scales of measuring instruments," which was prepared in 1908, and is now published at the suggestion of the Meter Panel of the Engineering Standards Committee on Electrical Accessories. A set of numerals is illustrated as designed by Mr. Trotter after examination of a large number of measuring instruments, including electricity meters, surveyors' staffs, and the Admiralty standard scales. The numerals were designed with the sole view of legibility, elegance of shape being taken into consideration, but sacrificed to legibility wherever necessary. The numerals were not designed separately, but the relations between the 3, the 5, and the 8, and between the 6, the 9, and 0, were considered with the object of preventing confusion. The width of the containing rectangle of each figure is 0·7 of the height, and the thickness of the lines uniform, with a minimum one-twentieth of the height.

National Illumination Committee of Great Britain.—The annual report states that the year 1915 has been somewhat uneventful, as a great part of the international work which was contemplated has been wholly suspended. The death of Mr. Edward Allen, the Chairman of the Committee, and the appointment of Mr. W. Duddell, F.R.S., to succeed him are mentioned. The Committee has only met twice, and in consequence of the interruption of the international work, the expenditure during the year was less than £10.

NEW TYPE OF STARTING RHEOSTAT

A NEAT form of starting rheostat for continuous-current motors is now being manufactured by the British Thomson-Houston Co., Ltd., Rugby, in which both switch and resistance are enclosed, the switch-arm being operated by means of a double lever pivoted in the cover, so that no slot is necessary in the switch-cover. This cover is of cast-iron of neat design, and is provided with a glazed opening in front of the contacts for inspection purposes. The rheostats, which are described in detail in the new B.T.-H. price list No. 5100-A, are designed to comply in all respects with the Home Office rules for the use of electricity in factories. They are supplied for circuits up to 550 volts, in sizes from ½ h.p. to 40 h.p. The smaller sizes have a switch fitted with a contact brush of the "skate" type, which is pressed on to the contacts by means of a steel spring. The larger sizes have a combination brush consisting of a carbon portion, to reduce sparking, and a brass portion which carries practically all the current. The resistance element is particularly good, consisting of a number of fireproof tubes wound with a special non-corrodible wire and fitted with porcelain insulators at each end, the whole unit being coated with a special cement. The complete units can be easily renewed. The frames and covers of the rheostats are black japanned, the slate panels have a dull black finish, and the brass and copper parts are lacquered, thus giving the complete rheostat a very neat appearance.

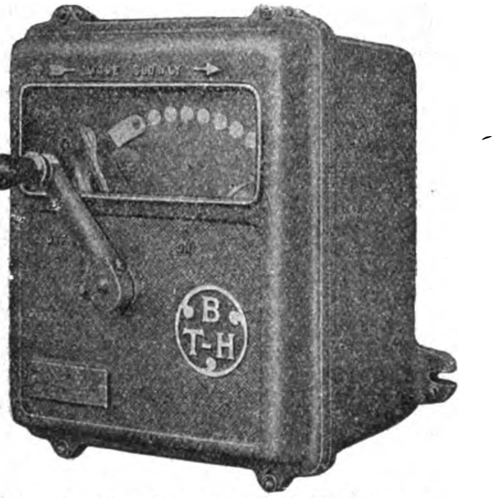


FIG. 1.—NEW ENCLOSED B.T.-H. STARTER.

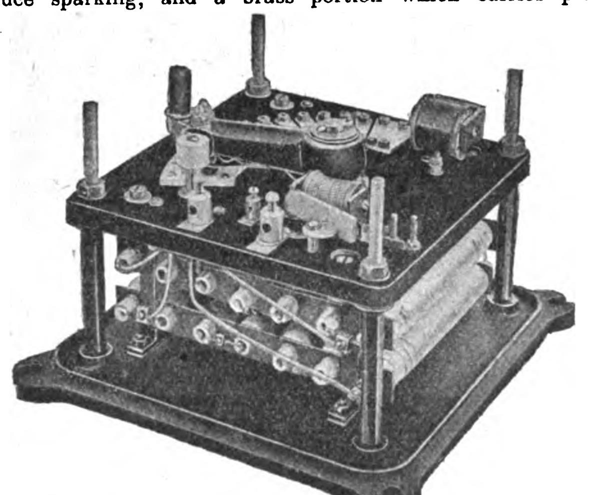


FIG. 2.—B.T.-H. STARTER WITH COVER REMOVED.

Patents in South Africa.—Mr. Benjamin T. King, patent agent, of 165 Queen Victoria Street, London, E.C., informs us that a Bill has been introduced into the South African Parliament which will have the effect of a patent or registration taken out in any of the South African States, being valid in all of them. This principle has already been established by the Australian Commonwealth, and it is to be hoped is but the preliminary to the establishment of the same principle throughout the British Empire, as has been urged by the Board of Trade Advisory Committee.

EXPULSION OF ENEMY MEMBERS OF THE INSTITUTION OF ELECTRICAL ENGINEERS

WE are informed that, as soon as the approval of the Board of Trade is obtained, the Council of the Institution of Electrical Engineers will call a special general meeting for the purpose of making the following addition to Article 41 of the Articles of Association :—

In the event of a state of war arising between Great Britain and any other country or State, any member of any class who at any time during such war shall be a subject of such enemy country or State shall forthwith cease to be a member of the Institution, and in the case of the European War of 1914 all such members shall cease to be members of the Institution on and after . . . [date to be inserted].

The Council have also received a petition signed by seventeen Corporate Members in regard to the expulsion of enemy aliens, asking that, in accordance with Article 80, the Council call a special general meeting for the purpose of dealing with the matter. It is understood that the signatories are of opinion that the alteration proposed by the Council will effect the object of the petition.

ELECTRIC TRACTION NOTES

A Board of Trade report has been issued with regard to a fatal accident which occurred on Dec. 6th to a porter who was engaged in shunting operations at Sunbury, on the L. & S.W.R. He apparently slipped under some wagons and was found fatally injured with one hand on the live rail. The line was being equipped for electric traction, and the conductor rail, though alive for the purpose of trial trips, was not yet guarded. The Report states that whilst the fact of the rail being unguarded may not have contributed to this accident, yet shunters and others are exposed to grave risks by lack of any guarding, and no line should be worked electrically until all places where men have to work alongside a conductor rail are efficiently guarded.

A Paper read before the Institution of Civil Engineers on Tuesday, by Mr. W. T. Lucy, comprises some notes on the working of the Chilian Transandine Railway on the combined rack and adhesion system. The conditions necessary in a combined adhesion and rack locomotive for an 8 per cent. (1 in 12½) gradient are considered in detail, comparisons being made between the Kitson-Meyer and the Esslingen types. The author contends that the plan hitherto generally accepted, of providing a separate frame, suspended on the carrying axles of the main frame, for carrying the rack pinions, is unnecessary, and he gives arguments in support of this. He also disagrees with the traditional method of driving the pinions by means of spring keys, and advocates solid ones as having given better results. He advocates the flexibility in speed obtained by a direct drive on the pinions, and therefore is opposed to the introduction of gearing. The eight separate brakes used on the Chilian Transandine Railway are dealt with, the value of the repression brake being particularly noted and modifications described which have added to its efficiency.

The difficulties which have prevented the Kingston Electrified "loop" line on the London & South Western Railway being opened have now been removed, and a service of trains commenced on January 30th.

Reports from Stockholm state that owing to the difficulty of obtaining fuel on account of the war, the Swedish Government has decided to go into the question of electrifying their railways, taking power from the numerous waterfalls.

British Industries Fair.—The Board of Trade has issued a memorandum of information for buyers in connection with the British Industries Fair, which will be held at the Victoria and Albert Museum, South Kensington, London, from February 21st to March 3rd inclusive. This fair will be open to the trade alone, and tickets of admission will be issued to *bonâ fide* buyers either at the entrance to the Fair or on application to the Director, British Industries Fair, 32 Cheapside, E.C. A catalogue will be issued and inquiry rooms provided at which official interpreters will be available. In this connection we have received a note from Messrs. Ward & Goldstone, stating that, notwithstanding their works being under Government control, they have been granted special permission to exhibit. Among the goods will be electric pocket lamps, torches, electro-medical apparatus, and electrical appliances for motor-cars, &c.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Feb. 3rd, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

324/15. **Telephones.** B. A. PILKINGTON. A microphone having for its loose portion an approximately spherical granular mass held in a freely rotateable manner between the two fixed portions in sockets forming a circular contact, the parts being held together by a spring. (One figure.)

1,091/15. **Wireless Telegraphy.** STERLING TELEPHONE & ELECTRIC Co. and T. D. WARD-MILLER. A cartridge form of wireless detector in which one contact element is held against the other by a spring, but can be withdrawn by an external handle and retained in the withdrawn position for transport. (Five figures.)

2,546/15. **Electric Fires.** H. H. BERRY and W. J. MARKHAM. The provision of electric radiators or convectors with an illuminating lamp, which is given a flickering effect to imitate a coal fire by a rotating shutter driven by fan-vanes rotated by the upward current of heated air. (One figure.)

11,314/15. **Cable Telegraphy.** W. JUDD, A. FRASER, and EASTERN TELEGRAPH Co. A current magnifier comprising an electrolytic cell in conjunction with condensers, relays, &c., and provision for periodically reversing the current applied to the cell, and afterwards rectifying it and ensuring the prevention of and excess of current in either direction. (Two figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: A.E.G. [Enclosed arc lamps] 11,660/15.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: PRESSLAND [Cable sockets] 677/15; HÖCHSTÄDTER [Stranded overhead conductors] 1,234/15; SEGRE [Moulded insulation] 10,901/15.

Dynamos, Motors, and Transformers: CARDELLINO [Generators and motors] 1,124/15.

Heating and Cooking: OPOCZYNSKI and HALPERN [Hot plate] 943/15; DENNIS [Electric vulcaniser] 8,524/15; PATE and WOOD [Heating apparatus] 12,924/15.

Switchgear, Fuses, and Fittings: PRITCHARD [Thermostatic switches] 1,212/15; GRAHAM [Switchgear] 12,143/15.

Telephony and Telegraphy: MARCONI'S WIRELESS TELEGRAPH Co. and FRANKLIN (Aerials] 24,098/14; GRAHAM [Telephone receivers] 15,369/15.

Miscellaneous: VULKAN MASCHINENFABRIKS A.G. [Electrical controlling apparatus for tool carriers] 1,284/15; WALL [Sparkless break of inductive circuit] 5,883/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

(The numbers in brackets are those which the Specifications will finally bear under the new system of indexing and abridging at the Patent Office.)

Ignition: W. SCHMIDT [Magnetos] 487/16 (100,018).

Switchgear: ALLMÄNNA SVENSKA ELEKTRISKA AKTIEBOLAGET [Time lag relays] 17,535/15.

Telephony: TURNER [Telephone systems] 18,084/15.

Traction: R. BOSCH [Engine-starting switches] 412/16 (100,017).

Miscellaneous: HEIBERG [Table lamp] 17,116/15.

Opposition to Grant of Patents

Opposition has been entered to a grant on the following application:—

23,676/14. **Heating Elements.** F. S. GROGAN. A frame of parallel heating-rods, the resistances of which are formed by coiling up flat strip with the adjacent convolutions only just separated at the outer part and spaced wider apart in the centre part of the frame to equalise the temperature all over.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

3,737/02. **Transformer Plate.** R. H. HADFIELD. A special iron alloy for transformer or armature core stampings containing 2 to 5 per cent. of aluminium or silicon, but free from carbon or manganese.

The following are the more important patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: A.E.G. [D.C. converters] 24,306/09.

Electrochemistry and Electrometallurgy: J. E. EVANS JACKSON [Electric furnaces] 24,302/09.

Instruments and Meters: T. W. VARLEY [Meters] 21,181/05.

Miscellaneous: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Electrical operation of bulkhead doors] 22,818/04; F. CASTLE [Fire alarms] 22,119/08; G. L. PATTERSON and G. H. HOPPER [Primary batteries] 11,155/09; SIEMENS & HALSKE [Fire alarms] 24,185/09.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,481.

In a large cold storage warehouse it is desired to have an indicator, say an ordinary 16-c.p. carbon filament lamp, coloured red, to determine if all lights are switched off before the premises are closed up for the night, this in case of a workman being accidentally locked up in one of the chambers. How could this be best accomplished with minimum risk of failure to the indicator?—E. W.

(Replies must be received not later than first post, Thursday, Feb. 17th.)

ANSWERS TO No. 1,479.

Describe a simple but reliable test, for daily use, of switch and transformer oils, *i.e.*, flash point, and insulating and cooling properties.—W. E. L.

The first award (10s.) is made to "L. R." for the following reply:—

There is no single test for all the features mentioned, neither do these cover all the tests which should be made. The following are simple and reliable ways used in practice for the testing of switch and transformer oils:—

Flash Point.—Take a porcelain crucible about 3 in. in diameter and 1½ in. deep, and place it on a sand bath and fill it for about two-thirds with the oil to be tested. Raise the temperature of the bath by a flame underneath it, and by means of a thermometer in the oil see that the temperature is progressively increased at the rate of about 8° C. per minute. At intervals apply a small gas test flame about ¼ in. in length just above the crucible until a flame flashes across the surface of the oil. This is roughly the "open"

flash point. It is about 10° C. less than the "closed" flash point determined by standard apparatus. It should not be less than about 180° C.

Fire Test.—The flash test should be continued until the temperature is reached at which the oil will remain ignited. This should not be less than about 200° C.

Insulating Test.—The breakdown test is the best to apply in this case. Take a long cylindrical glass jar holding about 200 c.cms. and $1\frac{3}{8}$ in. in diameter, with a hole at the bottom through which a $\frac{1}{2}$ in. brass rod is inserted and the joint made oil-tight. A cover is to be provided for a similar rod capable of fine adjustment, and the rods are to end in balls about $\frac{1}{2}$ in. in diameter. The gap between them should be about 0·1 to 0·2 of an inch. The voltage applied must be slowly and continuously raised until snapping sparks pass at short intervals. This gives the B.D.S.I. (breakdown short intervals) point. It is then continued until a continual passage of sparks takes place. This is the puncture voltage.

Cooling Properties.—These depend on the viscosity of the oil, chiefly because cooling is mainly done by convection currents. A proper viscometer is really required, but a substitute may be made by taking a metal funnel and closing the end with a steel plug which has a very fine hole drilled through it. The funnel is almost filled with the oil and the time taken for a definite quantity, say, 20 c.cms., to drip through the orifice is noted. It is important that the temperature should be constant for this test.

Moisture.—Place some of the oil in a porcelain crucible and plunge into it a heated iron rod. If it should crackle, moisture is present. The breakdown test also indicates this. Another test is to use some anhydrous copper sulphate, which turns blue with moisture.

Carbonising.—An arc should be struck under the surface of the oil and allowed to remain for some time. Observation of the results will easily show if carbonisation is to be feared.

Dirt.—Solid impurities often are found, and the easiest way to detect them is to mix the oil with an equal volume of ether or petrol; shake it well, when the dirt will separate. Finer results are obtained by filtering instead of separation by standing.

Congealing Point.—In the case of switches this is important. Some oil should be placed in a test tube with a thermometer, and this inserted in a mixture of ice and salt. The temperature when the oil refuses to flow can then be found.

Evaporation Test.—This is of some importance. It is made by placing 2 grammes of the oil in a beaker and water bath, and treating it for eight hours at 100° C. The loss should be not more than 0·2 per cent.

The second award is made to "M. M." for the following:—

The main points that stamp the suitability of an oil for transformer insulation are:—Freedom from moisture, high flash and burning points, low viscosity, neutral reaction, freedom from impurities, and should be a good insulator and dielectric.

Although quantitative tests are difficult to carry out and require elaborate apparatus, approximate results are fairly easy to obtain. Simple tests for moisture are:—(1) Take a sample of oil from lower part of containing vessel and stir with a red-hot wire; if water is present, a hissing sound is set up which is readily recognised. (2) Place a sample in an evaporating dish and raise to a little over 100° C.; any water present will be vaporised, and may be condensed on a sheet of cold glass held over the dish. (3) Half fill a small test tube with the oil and add some anhydrous copper sulphate. If water is present, the white salt will turn blue and tint the oil.

To measure the flash point elaborate apparatus is employed, but we can get a fair test by quite simple means. Heat some oil in an evaporating dish and take temperature with a thermometer. As the gas comes off, try with a lighted taper, and when small explosions are obtained take this as the flash point. The flash point should be about 185° C.

Viscosity is found by noting time a given quantity of oil flows through an aperture of definite area. This test should be carried out at the working temperature. A low viscosity is wanted in order that there may be good circulation.

By spreading films of oil on polished metal surfaces, any chemical reaction may be observed.

Sulphur is an objectionable impurity; this may be detected by placing a polished copper wire in the heated oil. If sulphur is present, the wire will be blackened by copper sulphide in from 20–30 minutes.

Electrical tests are rather more elaborate. Voltages up to about 40,000 are necessary with a sparking apparatus. This test should be taken at the working temperature.

THE FIRST ENGLISH HIGH TENSION D.C. RAILWAY

In connection with the description of the 1,200-volt D.C. railway of the Lancashire & Yorkshire Rly. Co. between Manchester and Bury, the following illustrations and particulars of some of the types of cables supplied by Messrs. W. T. Henley's Telegraph Works Co., Ltd., are interesting:—

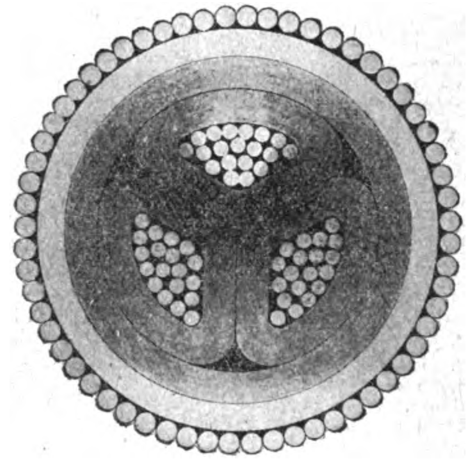


Fig. 1.—13,000 yards of three-core 19/14 S.W.G. shaped conductor, paper-insulated, lead-covered cable, with galvanised steel wire earth sheath, for a working pressure of 10,000 volts. The illustration shows the full size of the cable.

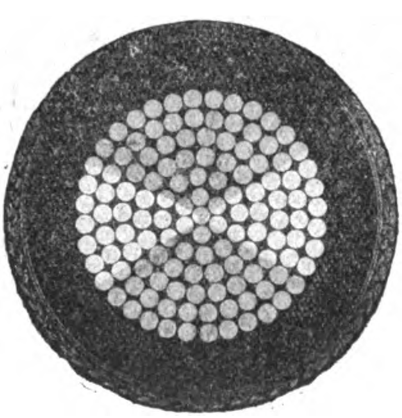


Fig. 2.—700 yards 1·0 sq. in. vulcanised bitumen insulated cable for a working pressure of 1,200 volts; also 250 yards of the same size cable, but for a working pressure of 100 volts.

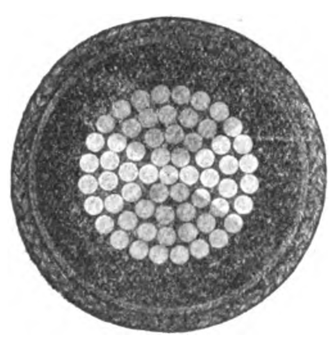


FIG. 3.

FIG. 4.

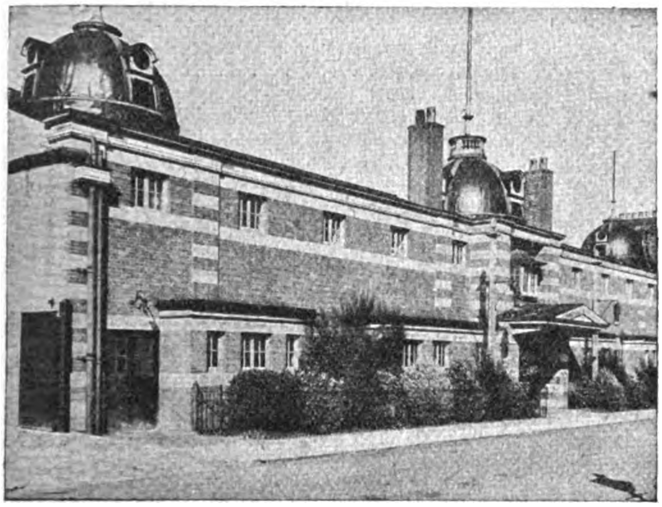
Fig. 3.—3,200 yards 0·5 sq. in. single bitumen insulated cable.

Fig. 4.—1,000 yards 7/15 S.W.G. twin paper-insulated, lead-covered, earthed steel-tape armoured and jute served cable; also 1,900 yards 7/18 S.W.G. paper-insulated, lead-covered and armoured to similar construction.

The B.E.A.M.A.—The following firms have been elected members of the B.E.A.M.A.:—Ferguson, Pailin & Co. and Mirrlees, Bickerton & Day. The following firm has been elected a member of the Council for the Session:—Callender's Cable & Construction Co.

MAZDA LAMP WORKS EXTENSION

OWING to the enormous increase in the demands upon the lamp works of the British Thomson-Houston Co., Ltd., at Rugby, the new plant which has been installed has trespassed on the normal storage space, leaving insufficient room to accommodate the usual stock. The B.T.-H. Co. has therefore



The New Mazda Lamp Store.

arranged for more storage capacity, and taken over the well-known Rugby skating rink. Our illustration shows the exterior of the rink. The annexe itself is already crowded, and a second floor has to be built immediately to facilitate working in the building, and add to its capacity. At the same time the existing medley of lighting devices will be replaced by high efficiency units on the well-known B.T.-H. principle.

CATALOGUES, PAMPHLETS, &c., RECEIVED

INCREASE IN DRY BATTERY PRICES.—The General Electric Co., Ltd. (67 Queen Victoria Street, London), notified that owing to the import duty on Motor Accessories, and to the Customs authorities' decision that "Helleson" dry batteries come under that heading, they are compelled to increase the catalogue prices to cover the new duty charge. A leaflet giving the new prices has been prepared, and supersedes the prices appearing on pages 1280-1 of the Motor Car Accessories Catalogue (11th edition).

SIMPLEX ANTI-ZEPPELIN REFLECTORS.—A copy of the catalogue No. 614, dealing with Anti-Zeppelin Reflectors, has been sent us by Simplex Conduits, Ltd. (Garrison Lane, Birmingham). These reflectors are made in two types, extensive and intensive, which terms define the distribution of the light. They are made of steel, enamelled dark green outside, with a special diffusing reflecting surface inside.

DIESEL ENGINES.—The "Crosshead" type of Mirrlees steel engine is described in a list from Messrs. Mirrlees, Bickerton & Day, Ltd. (Hazel Grove, Stockport). It is pointed out that the matter of cost has prevented the general adoption of the "Crosshead" type, but in the interests of reliability, economy, and smoothness of working, Messrs. Mirrlees, Bickerton & Day pin their faith to the "Crosshead" type, and claim that by their methods of manufacture these advantages are secured for only a small percentage increase of cost. This firm has also manufactured an air regulating device for Diesel engine compressors, one of the advantages of which is the facilitation of running alternators in parallel.

ROBERTSON LAMPS.—The General Electric Co., Ltd. (67 Queen Victoria Street, E.C.) have issued pamphlet R 1951, dealing with the numerous types of Robertson lamps. These are made in all voltages and many varieties, including candle lamps, "Striplite" for shop-window lighting, vertical heating lamps, and battery lamps. The list also gives particulars of varnish and frosting fluid.

EDISWAN CORRESPONDENCE CARD.—The Edison & Swan United Electric Light Co., Ltd. (Ponders End, Middlesex), have introduced a correspondence card, which they will overprint inside with customer's name and address, or on the other hand they are willing to supply these cards plain for private use in small quantities to contractors.

LOCAL NOTES

Birmingham: *Supply Charges.*—Owing to the increased cost of fuel and the general advance in the various items concerned in the generation of electricity, the Electric Supply Co. has under consideration a scheme for increasing the charges to meet this extra expense. In 1909 reductions were made in the charges, which had the effect of reducing the revenue by about £11,000 per annum, but the present position is such that the Committee feels it has no option but to revise the present charges.

Bradford: *Bulk Supply.*—The Board of Trade has intimated its intention of making an order authorising the Bradford Corporation to give a supply of electricity in bulk to the Yorkshire Electric Power Co., and any objections should be sent to the Board of Trade within fourteen days from January 27th.

Chiswick: *Increase in Supply Charges.*—A short time ago the Chiswick Electric Supply Corporation increased its charges by 10 per cent., but apparently it has not brought in the extra revenue necessary in view of the increased cost of generation, and the Company has now followed one or two of the other London companies in notifying its consumers that the minimum of 13s. 4d. allowed by their Provisional Order will be enforced. There is considerable dissatisfaction locally with this, but all the writers on the subject, here and elsewhere, appear to overlook the fact that any supply authority is within its legal rights in enforcing its minimum, although it is satisfactory to note that it is only being resorted to in a very few cases.

Dublin: *Indictment of Electricity Department.*—A serious indictment of the electricity undertaking in Dublin is made by Mr. P. W. d'Alton, who was called in as an expert by the Corporation in reference to the matter. Summarised, his views are as follows:—(1) The administration of the system is unduly complicated; (2) the charges for energy are unduly high for private supply, if not unreasonable for public lighting; (3) the cost of the secretarial department is high; (4) the system of coal supply needs careful overhauling; (5) the charges for interest and repayment of moneys borrowed are fair and are being admirably met; (6) the returns for units generated at the power-house are unreliable on account of the condition of the wattmeters; (7) the Stewart engines used for steam generation are obsolete and extravagant; (8) the condensers are, and have been for a long time, ineffective. The report is challenged in general, and in particular by the officials of the department.

Slander Action.—From a local newspaper cutting mentioning an application in the King's Bench Division, Dublin, for an order for "discovery of documents," it would appear that a member of the Electricity Department staff named Farrell has commenced an action for alleged slander against the City Electrical Engineer. The words complained of are said to be contained in statements made to the Chairman and Vice-Chairman of the Electricity Committee.

Manchester: *Increased Demand.*—The consumption of electric power during the December quarter shows an increase of nearly five million units compared with the December quarter of 1914. The Local Government Board has sanctioned an expenditure of £83,000 from the sum already authorised upon the Barton scheme for the purpose of installing machinery temporarily at the Stuart Street works to relieve the present congestion. The intention is to transfer this plant to Barton, when the latter power-house is in a position to receive it.

Portsmouth: *Electricity Employees Strike.*—Some of the stokers at the electric light and tramway power stations have joined the municipal employees at Portsmouth, who have come out on strike because the Corporation have refused to grant a war bonus. The various Committees, however, say they have made adequate arrangements to continue the public services.

Sheffield: *Kelham Island Power Station.*—At the recent Local Government Board inquiry relating to the transfer of the Kelham Island power station from the Tramway Department to the Electric Supply Department, the Town Clerk stated that the capital expenditure which would be transferred from the liability of the one department to the other would be £331,460. Of this, however, £99,000 has been repaid. The reason given to the Inspector for the transfer was the great efficiency which could be obtained if the supply for all purposes in the city is under the control of one department.

Wallasey: *Supply Interruption.*—The recent temporary stoppage of the supply from the new power station was referred to at the last meeting of the Electricity Committee, when the engineer reported that the whole trouble was caused by a stoppage of the circulating water. The turbine and generator were in no way at fault. Everything was put right in about three days, the set running on Friday, the 14th inst. (the interruption took place on the 11th), and is continuing to do so.

Wigan: *Supply Interruption.*—From the fuller accounts of the interruption in the supply on Friday, January 22nd, which was mentioned on p. 36 of our issue of January 27th, it seems that the reason for it was as stated, namely, a breakdown in the boiler-room through excessive demand on the plant. It appears that a scheme for extensions was sanctioned by the Council, and orders were placed, even before the sanction of the Local Government Board had been obtained, so urgent had the position become at the end of last summer. The agreement with the manufacturers of the plant was that it should be equipped and under steam in October. The exigencies of the war, however, have prevented the Stirling Boiler Co. from completing the contract in the specified time, and coupled with this has been an exceedingly rapid increase in the demand. The lighting supply was restored by Saturday, January 22nd, whilst the power supply was, generally speaking, available on Monday, the 24th. The trams were fully supplied by January 27th.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Bo'ness.—The Council has asked Mr. J. M. M. Munro, Consulting Engineer, of Glasgow, to report upon the condition and prospects of their electricity supply undertaking and the need for extensions.

London: *St. Pancras.*—The Finance Committee of the L.C.C. recommend sanction to a loan of £13,000 for buildings, foundation steel work, coal bunkers, and coal conveyer plant.

Woolwich.—The Finance Committee of the L.C.C. recommend sanction to a loan of £3,290 for mains, transformers, and switchgear.

Pembroke (Ireland).—Application for a loan of £15,000 for plant extensions is to be made.

Salford.—A loan of £13,660 for new plant is to be applied for.

Stoke-on-Trent.—Switchgear and transformers are required for a new sub-station to be constructed upon Messrs. Kerr, Stuart & Co.'s works. Borough Electrical Engineer.

Wiring

Bradford.—Electric light, wiring, telephones, and bells at Union Hospital, Horton Lane. Clerk, Union Offices, 22 Manor Row.

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. Wiring contractors are recommended to make inquiries to ascertain whether electrical work will be required.

Batley.—Extension to the Batley Hospital at an estimated cost of £4,500.

Cardiff.—Considerable extensions to the King Edward Hospital.

Dumfries.—New domestic science school, George Street. Architect, J. Bowie, 53 Buccleuch Street.

Exeter.—Electric lighting of the workhouse. Guardians.

Nottingham.—Cinematograph theatre, Welford Road. Architects, F. Ball & Smith, 23 King Street.

Miscellaneous

Belfast.—Electrical accessories, cable, and lamps for Tramways Department. Town Clerk. May 10th.

Bolton.—The Electricity Committee require a twelve months' supply of meters, motors, motor-starting switches, transformers, &c. Borough Electrical Engineer. March 2nd. (See an advertisement on another page.)

London: *Hammersmith.*—Twelve months' supply of electric lighting sundries, cable joint boxes and fuse boxes, &c. Borough Electrical Engineer. February 16th.

Finsbury.—Six months' supply of electric lamps. Town Clerk. February 14th.

Macclesfield.—Twelve months' supply of electrical goods for Cheshire County Asylum, Park Side. Clerk. March 15th.

Portsmouth.—Six months' supply of lamps, overhead line material, insulating materials, motor windings, &c., for Tramways Department. Town Clerk. March 15th.

Stockton-on-Tees.—Three months' supplies of stores. Electrical Engineer. February 15th. (See an advertisement on another page.)

APPOINTMENTS AND PERSONAL NOTES

The *Times* of Friday contained an announcement of the marriage, on January 31, of Mr. H. F. Parshall to Miss Ellen Payne, of Boston, U.S.A.

Mr. G. Dixon, Engineer to the Cleveland & Durham Electric Power Co., in the East Cleveland district, has been appointed, in addition, Electrical Engineer to the Skelton & Brotton Council, to whom the Power Co. is giving a supply.

The War Department, Southern Command, requires station engineer fitter, engine-driver, and wireman. (See an advertisement on another page.)

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £130–£132 (last week, £122 to £126).

Agencies.—A Toronto agent wishes to represent United Kingdom manufacturers of electrical machinery and supplies. —A Montreal agent wishes to get into communication with United Kingdom manufacturers of electrical goods. Further particulars at 73 Basinghall Street, E.C. The *Board of Trade Journal*, in making these announcements, calls attention to the prohibition of the export of certain goods from the United Kingdom, and recommends British firms to examine these before taking the matter up.

Westinghouse Hot-Pot Supper.—The annual hot-pot supper and smoking concert of the Supply Department was held on Friday, January 21st, at the Exchange Hotel, Manchester, when thirty-two members of the staff, and friends, were present. Mr. J. Gibson, Manager of the Department, in proposing "The British Westinghouse Co.," referred to the loyal feelings existing between the Company and the staff. The Company treated their staff well, and in return the staff reciprocated by the loyal way in which they carried out their duties. Thanks to their devotion to their work, loyalty to the Company, and the co-operative spirit amongst themselves, the Department had had a record year, the turnover having increased by nearly 70 per cent. He concluded by expressing sincere regret that many members of the staff had fallen in the war.

Coal Supplies.—The Board of Trade has appointed District Coal and Coke Committees with the object of ensuring that munition firms and other important consumers obtain the supplies they need with as little delay and trouble as possible. A Committee has been appointed to deal with problems arising. This action of the Board of Trade should relieve electricity works of the anxiety that has existed in some cases in connection with coal supplies.

Arrangements for the Week.—(*To-day*) *Thursday, Feb. 10th.*—Institution of Electrical Engineers. "The Testing of Underground Cables with Continuous Current," by O. L. Record, 8 p.m.

Friday, Feb. 11th.—Physical Society, Imperial College of Science, S. Kensington. (1) "On a General Bridge Method for Comparing the Mutual Inductance between Two Coils with the Self-Inductance of One of Them," by Prof. C. H. Lees. (2) "An Enclosed Cadmium-Vapour Arc Lamp," by Dr. H. J. S. Sand. 5 p.m.

Saturday, Feb. 12th.—Birmingham & District Electric Club. Swan Hotel, New Street. "Electric Welding," by W. H. Wolton.

Monday, Feb. 14th.—Institution of Post Office Electrical Engineers, at Institution of Electrical Engineers, Victoria Embankment. "The Western Electric Co.'s Semi-Auto Telephone System," by J. Hedley, 6 p.m. Electro-Harmonic Society. Ladies' Night, Holborn Restaurant, 8 p.m.

Wednesday, Feb. 16th.—Institution of Electrical Engineers, Students' Section. "The X-Ray Tube and Modern Practice," by W. J. Jones.

Thursday, Feb. 17th.—Institution of Electrical Engineers. The Seventh Kelvin Lecture, "Terrestrial Magnetism," by Dr. C. Chree.

ELECTRICAL ENGINEERING

With which is Incorporated

THE ELECTRICAL ENGINEER

(Established 1884)

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SUMMARY

A NUMBER of books are reviewed (p. 56).

AT the January meeting of the Diesel Engine Users' Association Mr. Charles Day made some interesting remarks upon tars and tar oils as fuel (p. 56).

AT the Manchester Section of the Institution of Electrical Engineers, on Tuesday last week, and in London on Thursday, Mr. O. L. Record described the "Delon" method of testing cables with rectified alternating current, so as to avoid the risk of permanent strain on the dielectric by subjecting it to an A.C. test both before and after laying (p. 57).

IN a paper on "Hydro-electric Power in New Zealand," published in the current issue of the Institution *Journal*, Mr. W. Wilson describes the possibilities of New Zealand with regard to the provision of power from natural hydraulic resources (p. 58).

AMONG the subjects of specifications published last Thursday at the Patent Office were cables, circuit breaking, tungsten arc lamps, and telephony (p. 59).

OUR "Questions and Answers" page this week deals with the cause of bad regulation of a generator which has been converted from shunt to compound (p. 59).

SOME notes on experiments with the million-volt transformer erected at San Francisco are given (p. 60).

OUR "Traction Notes" contain reference to an article on the efficiency of operation of electric trains, which discusses the most economical rates of acceleration, braking, and speed of trains, and the relations of the various factors in economy of car operation (p. 60).

WE publish further lists of members of the Institution of Electrical Engineers serving with the Forces, and also additional promotions, etc. (p. 61).

DR. J. A. FLEMING, F.R.S., read a paper before the Royal Society of Arts, on Feb. 9th, on "The Organisation of Scientific Research," in which he argued that the nation should avail itself of the services of the existing learned societies and institutions (p. 61).

THE Marylebone electrical apprenticeship scheme is practically ready to be put into operation.—The coal contracts of the Birmingham electricity and gas departments are to be pooled (p. 62).

NEW plant is required at Accrington, Barrow, Birkenhead, Pembroke, and Manchester (p. 62).

THREE of the London electric supply companies have been compelled, owing to the increased costs and reduced revenue due to the war, to pay smaller dividends for 1915 than in 1914 (p. 62).

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

COMPANY ORDERS BY LIEUT.-COL. C. B. CLAY, V.D., COMMANDING.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

(*To-day*) *Thurs., Feb. 17th:* Shooting for Sections III. and IV.

Fri., Feb. 18th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Feb. 19th: Adjutant's instruction class at 2.30 p.m.

Mon., Feb. 21st: Sections I. and II., technical. Sections III. and IV., lashings and trestle bridging. Signalling class and recruits.

Tues., Feb. 22nd: School of arms, 6.0 to 7.0 p.m.

Thurs., Feb. 24th: Shooting for Sections I. and II., and signalling class.

Fri., Feb. 25th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Feb. 26th: Uniform parade, 2.45 p.m.

Sections for technical parade at Headquarters, London Electrical Engineers, 45 Regency Street, S.W.

Sections for shooting parade at miniature ranges.

Unless otherwise ordered, all parades at Chester House.

Forty per Cent. Rise in Prices.—We learn, through a Swiss source, that nine of the principal electrical manufacturing firms in Germany have decided upon a further increase of 10 per cent. in the price of dynamos, motors, and other electrical machinery, railway, and tramway material and switches as from February 1st. This brings the total increase in price to 40 per cent., and is accounted for by rise in the cost of raw materials. For contracts not for war purposes, a further advance in price is proposed.

(*For "Arrangements for the Week" see p. 62.*)

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Elementary Lessons in Electricity and Magnetism. By S. P. Thompson, F.R.S. 744 pp. 6½ in. by 4½ in. 877 figures. (London: Macmillan and Co., Ltd.) New edition. 4s. 6d.; abroad, 4s. 11d.

IN our joy and gratitude for having a new edition of "Silvanus" after twenty years, we can forgive him much. We can forgive him for allowing one of the only two pictures of electric motors to be a Ritchie electromagnetic engine with a two-part mercury cup commutator of the A.D. 1833 pattern; we can forgive him for retaining the single-pole Bell as the only illustration of a telephone receiver; we can forgive him for devoting only eleven lines to dry cells, and a page with two illustrations to the Bunsen; we can even thank him for not cutting out the delightful picture of the Italian gentleman with wavy hair, taper fingers, and a three-legged and be-tailed cat-skin, presiding over an electrophorus; but we find it difficult not to blame him for allowing the 1895 edition to be reprinted twenty-one times before he revised it in 1915.

Principles of Direct-current Machines. By A. S. Langsdorf. 404 pp. 8½ in. by 5¾ in. 313 figures. (New York: McGraw-Hill Publishing Co.; London: Hill Publishing Co., Ltd.) 12s. 6d. net.

The author has treated in an original manner a subject on which a vast amount of matter has already been published. Whilst this book does not pretend to be a treatise on design, the most important features of the operation of machines, on which design depends, are considered thoroughly and in an up-to-date manner. Particularly noteworthy are the chapters on the operating characteristics of generators and motors, on commutation, and on the compensation of armature reaction. These chapters include a considerable amount of new material, and develop a more extensive treatment of the subjects than has hitherto been easily accessible to the student. Each chapter treats in a thorough manner some special phase of the subject, and would form a good introduction for the student or engineer who wishes to make a study or research on any particular feature of the operation or design of direct-current machines. While the methods of the calculus have been freely used, special prominence has been given to the physical conceptions underlying the mathematical investigations.

The book is the first of a new general series entitled "Electrical Engineering Texts," and is sufficiently attractive to make us look forward with interest to the appearance of future volumes.

The Electric Railway. By A. M. Buck. 390 pp. 9¼ in. by 6¼ in. 193 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 12s. 6d. net.

The author's method of dividing this wide subject into sections, the sound treatment given to each section, and the up-to-date information contained, combine to make this book a valuable addition to the literature on electric railways. Although intended primarily as a text-book, the volume undoubtedly contains much matter concerning underlying principles of interest to the practising engineer. No attempt has been made to write an engineer's note-book, and definite figures have been given only when necesary to make the text clear. There is a separate section on the mechanics of traction, a knowledge of which must form the basis of serious study of the subject. This is followed by a useful treatment of traction-motor characteristics, all the standard types of motors being considered. Other sections deal with motor construction, train control, energy consumption, braking, car equipment, locomotives, track construction, as well as the generation, transmission, and distribution of power. A valuable section on signalling systems is included, and the book concludes with a discussion of the relative merits of various systems of operation, and of a number of engineering preliminaries which have to be dealt with at the inception of any undertaking.

Diesel Engines for Land and Marine Work. By A. P. Chalkley. With an introductory chapter by the late Dr. R. Diesel. 364 pp. 8¾ in. by 5½ in. 181 figures. (London: Constable & Co., Ltd.) 4th edition. 8s. 6d. net; abroad, 9s. 5d.

Mr. Chalkley's book on the Diesel engine has, since we welcomed it in our columns in 1912, been recognised as a standard work on the subject, and in its fourth edition has been thoroughly revised and considerably added to to keep pace with the rapid advances in this branch of engineering. In particular, the number of drawings and descriptions of new designs of engine has been increased, and there is an additional chapter on modern practical design. The late Dr. Diesel's introduction is still retained, and at this time it is interesting to quote two sentences, which, as a German, he wrote therein: "England is the greatest colonizing country in the world. England is the greatest marine nation in the world." This was, of course, *apropos* of the rise of the Diesel engine for marine work, and it is this field to which the greater part of the book is devoted. Some of the latest engines used on submarines are illustrated, and the interest of electrical engineers will also be attracted by the author's expression of opinion that, for Diesel locomotives, probably the development will be in the direction of electric transmission. He also predicts the application in a similar way of small Diesel engines to road traction.

The Practical Electrician's Pocket Book for 1916. Edited by H. T. Crewe. 477 pp. and diary. 5¼ in. by 3¾ in. 253 figures. (London: S. Rentell & Co., Ltd.) Cloth, 1s. net; by post 1s. 3d.; Rexine, 1s. 6d.; by post 1s. 9d.

Those who are practically engaged in one or other of the many electrical industries will find this a most useful little book. While it is only about the the same size as last year, it has been found possible by careful condensation, and omission of out-of-date matter, to include several new sections. These deal with such subjects as electric vehicles, drills, blowers, lifting magnets, pumping plant, mining telephones and shaft signals, &c. A directory of central lighting stations, with details and prices of supply, is included at the end.

"Mechanical World" Electrical Pocket Book for 1916. 240 pp., 6¼ in. by 4¼ in.; 130 figures. (Manchester: Emmott & Co., Ltd.) 6d. net.; by post, 8d.

This book, which is published as a companion volume to the well-known "Mechanical World Pocket Diary," contains much useful information for the electrical student and engineer. The present issue has several new features, including a lengthy section on switchgear, a treatment of the subject of earthing, extension of the notes on accumulators to include particulars of alkali cells, the Edison cell, and others. The sections on lighting circuits, lamps, and switching, have been brought up to date, and the book generally has been thoroughly revised.

Wireless Telegraphy. By Dr. J. Zenneck. Translated from the German by A. E. Seelig. 443 pp. 9¼ in. by 6¼ in. 468 figures. (New York: McGraw-Hill Book Co; London: Hill Publishing Co., Ltd.) 17s. net.

This is a translation of one of the best known of German books on the subject of "wireless." The original is a very comprehensive treatment of the subject, although arrangements and devices of scientific interest are discussed which have either not been used to date or are no longer used in practice. The translator has adhered very closely to the original, and states that when tempted to add something or modify statements, he has refrained from doing so in order to let Zenneck be Zenneck. The present issue is very profusely illustrated, and an extensive and useful bibliography of the subject is appended.

Diesel Engine Users' Association.—At the January meeting of the Diesel Engine Users' Association the subject of the use of tars and tar oils as fuel for Diesel engines was discussed. Mr. Charles Day, who has carried out tests in connection with this subject, referred to the recent very great increase in the price of fuel oil, and to the importance of endeavouring to secure suitable supplies from other sources. Tars and tar oils appeared to provide a suitable alternative to petroleum oils. Such liquid fuel was produced by gasworks, coke ovens, blast furnaces, gas producers, and from the low temperature distillation of coal. He dealt at length with the nature of the product from these various sources from the point of view of suitability for use as fuel in Diesel engines, and referred to the fact that such fuels had been successfully used on the Continent, where the higher prices charged for petroleum oils had encouraged the adaptation of Diesel engines for the use of tar oils and tars. The ignition difficulties with tar oils had been completely overcome by a simple arrangement, by means of which a small quantity of petroleum oil was injected into the cylinder of the engine slightly in advance of the tar oil. In referring to the question of a suitable specification for tar oils for use in Diesel engines, Mr. Day mentioned that a very strict stipulation as to calorific value was not necessary, as numerous tests had shown that this is not a very variable quantity. Mr. Day estimated that the cost of carrying out the necessary alterations to engines manufactured by his firm for adapting them to the use of tar oils, including a new needle valve casing, ignition pump, and device for controlling the pump, would be in the neighbourhood of £1 per h.p., and that the cost would be paid for in one year.

There was a short discussion on the subject by other members, and subsequently Mr. Day explained the advantages of the crosshead type of Diesel engine with forced lubrication.

Conversazione.—The annual conversazione of the Battersea Polytechnic, Battersea Park Road, S.W., will be held on Saturday, February 26th, at 7 p.m. There will be an orchestral concert in addition to an exhibition of students' work, &c.

E.H.T. TESTS ON CABLES WITH CONTINUOUS CURRENT

A PAPER on the above subject was read before the Institution of Electrical Engineers at Manchester on Tuesday last week, and was also discussed in London on Thursday. The author stated that, as a rule, a cable was tested again at double working pressure after it had been laid. In the case of a short cable or network, say only one or two miles long and with a test pressure of 10,000 volts, the size of the transformer or transformers required was not great; with a frequency of 50 cycles per second, the charging current would only be 2 or 3 amperes, and a 20-kw. transformer would be sufficient. When, however, the pressure was higher and the network larger, much bigger charging currents were, of course, required; for instance, at 40,000 volts and a network extending 12 miles, the current might be 27 amperes, corresponding to a transformer capacity of 1,000 kilovolt-amperes. Another point arises, the author explained, namely, that the testing with alternating currents causes a fatigue on the insulating materials, which, it is now recognised, may be permanent, and this fatigue is a function of the time for which the higher voltage is applied. For this reason manufacturers oppose a repetition of the alternating pressure test above working pressure after the cables have been laid.

By substituting a continuous-current test for an alternating one, there are two advantages. The only current required is the small amount necessary to charge up the cable, so that the apparatus need only be one of comparatively small power. Moreover, there is no heat produced in the dielectric during the course of the test, and the breakdown voltage has a fixed value which does not decrease when the period of application is prolonged. The author described the "Delon" apparatus for testing with high-pressure continuous current. Fig. 1 illustrates the principle of the apparatus. T is a contact-

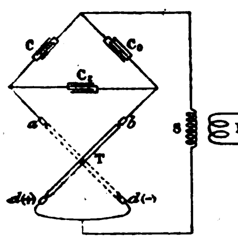

FIG. 1.

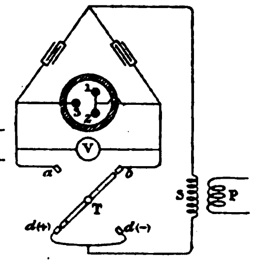

FIG. 2.

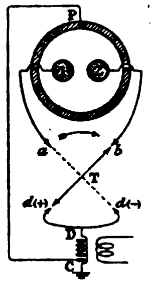

FIG. 3.

maker embedded in a revolving ebonite disc, and four fixed contacts a, b d (+), and d (−) are placed so that the conductor nearly touches them as it rotates, the actual connection being made by sparking across. The contact-maker is driven by a synchronous motor fed from the A.C. circuit, which furnishes the high-tension current by means of the transformer PS. The contacts are arranged so that they come into operation at the maximum points of amplitude of the pressure wave. If the sequence of operation is traced out, it will be seen that with the condenser C_2, which represents the cable under test, will receive a charge in the same direction at each position of the contact-maker.

The whole apparatus, suitable for testing cables up to approximately $2 \times 30{,}000 \times 1{\cdot}4$—*i.e.*, 84,000 volts—is contained in a handcart, the total weight of which is just over half a ton. By increasing the primary voltage it is possible to test up to 100,000 volts with this apparatus, and it is quite easy to mount in a similar cart apparatus sufficient for testing up to 150,000 volts. A transformer of 3-kw. capacity has been found sufficient in practice, and the maximum pressure is always obtained within a few minutes on a well-insulated cable system. A stationary apparatus constructed on the same principle and installed in the laboratory of the Société Française des Câbles Electriques is capable of giving a pressure of 350,000 volts. Fig. 2 shows the connections in the case of a three-core cable. The test is first made with conductors 1 and 2 connected together, and conductor 3 connected to the lead, and then 1 and 2 are connected to the lead and 3 is made the live conductor.

In actual practice, however, the auxiliary condensers are usually dispensed with, the cable itself providing the capacity. Fig. 3 shows the connections for a two-core cable arranged in this manner. In this case one of the conductors of the cable is subjected to a pressure always of the same sign and equal to the maximum positive value of the alternating electromotive force, viz., $+E\sqrt{2}$, and the other to a pressure equal to the maximum negative value, viz. $-E\sqrt{2}$, so that there is at any instant between the two conductors under test a difference of potential equal to double the maximum voltage, viz., $2E\sqrt{2}$. The transformer is constructed for a ratio of 110 (or 220) to 30,000, and the motor driving the contact-maker is driven at half the speed of synchronism. To test between each conductor and lead at the same pressure as between conductors, it is necessary to connect brush a to the lead, conductor 2 to the terminal of the transformer C, and brush b to conductor 1, and then to reverse the connections to 1 and 2.

Fig. 4, A and B, shows the two successive connections

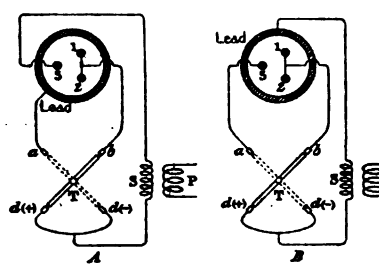

FIG. 4.

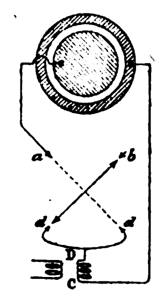

FIG. 5.

for testing three-core cable in a similar manner. With single-core cable, as there is no other conductor to act as an intermediate condenser, the connection shown in Fig. 5 must be used if auxiliary condensers are dispensed with.

A Villard-Abraham electrostatic voltmeter, measuring up to 100,000 volts, is employed to indicate the pressure.

To give the equivalent of alternating current as regards breakdown stress on the cable, experiments have shown that from three to four times the corresponding alternating voltage must be applied, not merely 1·4 times as might at first thought be expected.

The author described a test made to ascertain whether the apparatus would furnish sufficient power to burn out a fault sufficiently to enable a localisation test to be carried out. A piece of three-core cable, 50 sq. mm. section, 20 yards long, designed for a working pressure of 10,000 volts, was connected up as in Fig. 4. In its normal condition this cable withstood a pressure of more than 80,000 volts, and to obtain a fault it was necessary to flatten it out with a hammer near one end. The cable thus injured withstood 74,000 volts; but on increasing the pressure to 80,000 volts the voltage suddenly dropped to 32,000, and remained at that figure some time. At this point the insulation resistance was too high to be measured with a galvanometer and battery. On forcing the transformer and increasing the total current, including that taken by the synchronous motor, to about 10 amperes at 110 volts, however, the pressure gradually decreased and fell to zero at the end of 8 to 9 minutes, the insulation resistance falling to zero at the same time. On opening up the cable it was evident that the puncture had occurred between the cores, and that the subsequent charges had been sufficient to carbonise the insulation completely.

At the meeting in London, Mr. C. P. Sparks (the President) occupied the chair, and Mr. B. Welbourn, who opened the discussion, first congratulated Mr. Sparks upon his eldest son, Lieut. A. C. Sparks, R.E., having been awarded the Military Cross for valour in the field, a distinction which had already been gained previously by his third son, Capt. Harry Sparks (Suffolk Regt.).

Mr. Welbourn criticised the author of the Paper for not having prefaced it with an account of the work which had already been done in this country in the same direction, mentioning particularly Mr. Rayner's investigations and the machine for testing with high-tension continuous current made by Mr. E. A. Watson. The Paper only mentioned foreign investigators, and left the erroneous impression that nothing had been done here. Mr. Welbourn himself had been one of those using high-tension D.C. machines for testing cables years ago, but he had abandoned this because A.C. cables should be tested with alternating current, and also because of the flimsy construction of the machines. Testing with alternating current at the cable factory was absolutely necessary, but, of course, in some cases this would be troublesome to repeat after a cable had been laid and jointed up. For instance, to test 9 miles of cable at 40,000 volts and 25 cycles would require a transformer capacity of 1,290 k.v.a., weighing about 20 tons, and for this there was not only first cost to consider, but also the cost of transport. The author was wrong, however, in suggesting that cable manufacturers were against the testing with E.H.T. alternating

current after laying, on the ground that the strain of the factory and subsequent tests were additive; for, although the time element came in when applying the test for dielectric strength, the cable returned to its normal condition after the pressure was removed. If it had, for instance, withstood double working pressure once for half-an-hour, the test might be repeated later for subsequent periods of half-an-hour without the cable breaking down; this had been done frequently, and there was no doubt about it.

Mr. A. P. Trotter called attention to the scientific work of Evershed (ELECTRICAL ENGINEERING, Vol. IX., 1913, pp. 663 & 678) and Addenbrooke on the same subject, and the practical Papers read before the Institution by Beaver (ELECTRICAL ENGINEERING, Vol. X., 1914, p. 597) and Vernier (ELECTRICAL ENGINEERING, Vol. VII., 1911, pp. 135, 147, 151, 208, 328). The original test called for by the Board of Trade had been twice working pressure applied for half-an-hour; subsequently for cables for over 10,000 volts pressure; this had been modified to the working pressure *plus* 10,000 volts, but still for half-an-hour. It was open to doubt whether a full half-hour's test was necessary, as it might put undue stress on the cable, and more consideration might be given to this in the light of the valuable experimental work which had been carried out by Mr. E. H. Rayner.

Mr. F. C. Raphael laid emphasis on the fact that the stress to which continuous current subjects the dielectric is quite different in nature to that produced by alternating current, and contended that the ratio of 3 or 4 to 1 as the continuous- and alternating-current breakdown voltages might apply to certain cables which had been experimented with, but not to all cables and all faults. The old method of testing cables and breaking down faults with step-up transformers whose secondaries were connected in series had answered well for years, but it certainly incurred risks in unskilled hands, owing to the possibility of setting up higher voltages than were intended, through resonance effects, and, of course, as had been said, the enormous size of the apparatus necessary for the simultaneous testing of great lengths of cable made it impossible to use it for this purpose. The best plan of all to enable tests to be made after laying was to use a cable with a metal test sheath a little way under the lead, and separated from the latter by a comparatively thin layer of insulation, as proposed by Mr. Beaver in his recent Paper. The Germans were now making shift with zinc conductors for their cables instead of copper, and this suggested the use of zinc for the test sheath, for the conductance would not matter, and the thickness of metal to give the necessary mechanical strength could thus be had at a lower cost than with copper.

Mr. E. A. Watson said that the description of his high-voltage D.C. machine for testing, referred to by Mr. Welbourn, had not been published. It was an influence machine designed to give ½ kw. with pressures up to 150,000 volts (compared with the one or two watts of the ordinary influence machine). The rotor consisted of 30 plates 12½ inches in diameter, and the sectors were of sheet brass let into ebonite. It was operated in air under a pressure of about 15 atmospheres, as the machine output was limited by the dielectric strength of the air, which was increased at high pressure. The machine ultimately broke down owing to disintegration of the ebonite. The number of sectors proved to be too few and their size too large, and high voltages and surgings were produced between the various parts of the machine.

Mr. J. Warren said that the Delon apparatus seemed to call for expert management in the decision of the value and duration of tests for various cases.

Mr. H. M. Sayers said that the taking of an accurate insulation test after laying and comparing it with the factory test gave a fair indication as to whether the cable had been damaged. He endorsed Mr. Raphael's approval of the test sheath. Finally, he mentioned that a way of avoiding high-capacity currents was to test with a separate engine at a low frequency. [This has a similar disadvantage, though in a lesser degree, to the D.C. test. The dielectric hysteresis losses which heat and strain the dielectric are lower at the lower frequency.—ED., *E.E.*]

Mr. Rosling said that, as the testing of long lengths of cable at once was only rendered really necessary in order to test the joints, it would be simple, say, to test the cable in four sections and to make the three remaining joints with special care.

The President, in closing the discussion, referred to some passages which occur in the full text of the author's Paper, and deplored the habit, now becoming too common, of decrying British methods and practice, with the result that people abroad took us at what they thought was our own valuation. British cables had always been better than any others; makers had always been prepared to fulfil any specification of his, and he had never experienced any opposition from them. He agreed with those speakers who had insisted that an A.C. test was necessary after manufacture, but after laying it was only required for testing the joints and not the cable; he had experienced little difficulty in dividing cables into sections for this purpose, and had not used high tension D.C. testing. By various references, such as those to repetition of tests, the author and others seemed to imply that cables required a kind of "nursing" after they were laid. No such thing, however, was necessary; when cables were once laid and in service accidents were a very remote contingency.

The Author, in a brief reply, said it had not been his intention to say anything detrimental to British cable manufacturers. The main object of his Paper had been to describe the Delon testing apparatus.

HYDRO-ELECTRIC POWER IN NEW ZEALAND

A LONG and interesting Paper by Mr. W. Wilson, describing the possibilities of New Zealand with regard to the provision of power from natural hydraulic resources, is published in the Feb. 1st issue of the *Journal* of the Institution of Electrical Engineers. After a brief description of the country and a history of early enterprise, the writer discusses the varieties of water-power schemes rendered possible by the varying physical features of the country. The most numerous potential power sites, and generally those involving the least expense in development, occur among the mountains of both islands, where there is a myraid of large and small cataracts and waterfalls. The best conditions, however, with this type usually occur in hardly accessible situations, and the water supply is not very constant. It is, therefore, from the big rivers and lakes of the lower country that most power is at present being drawn, and these afford the greatest possibilities for the future. The extreme south-west of the colony possesses a long stretch of coast-line indented with deep fiords, and a host of lakes is found within a few miles of the waterfronts, and these, together with a rainfall estimated to provide 2,000 b.h.p. per mile of drainage area, give conditions almost unparalleled in the world for the cheap generation of power, closely resembling those in the favoured portions of Norway.

With regard to the water power available, a table is given showing the sources of natural energy, in all of which the development is devoid of serious difficulty, the total horsepower represented being 495,000 for North Island and 3,305,480 for South Island. In addition to this, there are numerous smaller sources of less than 1,000 h.p. each which have not been included.

A section on the attitude of the Dominion Government to water-power development shows the enterprise of the Government, which, without closing the way to private development, is carrying out a comprehensive scheme of its own for providing electricity to residents and industries throughout the country. With regard to water power in present use, a table given by the writer shows that, of a total of 35,000 h.p., rather over two-thirds is used for the generation of electricity.

A short description is given of seven of the chief stations already in operation, with details of the water supply, illustrated by maps, and of the construction and equipment of the stations themselves. The largest of the Government schemes to reach completion is that at Lake Coleridge, which supplies the city of Christchurch, seventy miles distant. The power plant here consists of four Francis turbines of 1,500 h.p. each, driving Bruce-Peebles alternators at 500 r.p.m., whilst two more sets of 3,000 h.p. each are to be added.

With regard to schemes for the future, it is probable that the next large undertaking will be the carrying out of one or more Government projects in the North Island, for the Official Year Book has recently announced that "a large and comprehensive scheme is now under consideration for the supply of electrical energy in the North Island, with the object of making it generally available, as far as possible, to all the towns and districts throughout the island. It is anticipated that advantage will be taken of the facilities offered to work the railways by electricity and to promote a system of light railways throughout the country districts now suffering from lack of communication."

After a long and interesting treatment of the subject, the writer states his conclusion that hydro-electric power in New Zealand is plentiful, cheaply produced, and useful. Add to this the proximity of many of the largest power-houses and prospective electrical factories to deep-water harbours, the existence of an unusually good and healthy climate, and other favourable local conditions, and also the wise and liberal Government of the British type in power in the Dominion; in such advantageous circumstances the field for the generation and utilisation of electric energy cannot but be a particularly bright one.

American Submarine Explosion.—Gas from accumulators was responsible for an explosion on an American submarine at the Brooklyn Navy Yard on January 15th, resulting in the death of four men and injuries to a number of others. A Board appointed by the Navy Department to investigate the matter was unable, however, to ascertain the cause of the spark which produced the ignition of the gas.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Feb. 10th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

1,234/15. **Cables.** C. HÖCHSTÄDTER. Stranded cables for aerial transmission lines with an insulated pilot wire embedded among the other strands, which are uninsulated. (Two figures.)

5,883/15. **Circuit-breaking.** T. F. WALL. A sparkless break of an A.C. inductive circuit is obtained by the employment of an asymmetrical pressure wave which reaches zero value coincident with the current wave. This can be done by the superposition of a continuous-current E.M.F. The method is applicable to rock drills and similar apparatus. (Two figures.)

11,660/15. **Tungsten Arc Lamp.** A. E. G. An arc lamp with tungsten electrodes enclosed in an inert gas in which the radiating surface of the pointed cathode is made so small that the temperature is higher than that of the anode, the auxiliary kindling cathode being made of similarly small dimensions. (Four figures.)

15,369/15. **Telephone Receivers.** E. A. GRAHAM. Receivers in which the distance between the diaphragm and the moving system is adjustable by a central screw acting in opposition to a number of springs arranged at points around the screw in conjunction with guides and stops. (Three figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires; Insulating Materials, &c.: SIEMENS-SCHUCKERTWERKE GES. [Protective vacuum relays] 722/15.

Electrometallurgy and Electrochemistry: SAMUEL [Treatment of air in arc furnace] 1,670/15; G. MENDHEIM [Electrodes] 3,442/15.

Heating and Cooking: MARKS (*Landers, Frary, and Clark*) [Toasters] 7,006/15; MCKINNON [Air heater] 7,433/15.

Switchgear, Fuses, and Fittings: LUNDBERG, LUNDBERG, LUNDBERG, and PEGG [Switches] 4,046/15.

Telephony and Telegraphy: WAGNER [Insulation of telephone cables] 1,346/15; RELAY AUTOMATIC TELEPHONE Co. [Automatic and semi-automatic telephone systems] 1,470/15; EASTERN TELEGRAPH Co. and GARDINER [Telegraphy] 4,348/15.

Traction: MOSSAY [Motor-driven trucks] 1,582/15; BOOT and SCOURFIELD [Signalling] 5,076/15; SAMUEL, SLINGO, GUNTON, and DOUGLAS [Brake for electric vehicles] 9,915/15.

Miscellaneous: J. STONE & Co. and DARKER [Control of currents] 1,093/15; CREAGH-OSBORNE, HUGHES, and H. HUGHES & SON, LTD. [Compasses] 1,148/15; JOEL [Batteries] 1,525/15; WEBBER and STANDARD TIME Co. [Electric clocks] 1,641/15; FAIRWEATHER (*Wallace Novelty Co.*) [Portable lamps] 2,388/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Stereoscopic X-ray apparatus] 6,807/15; RATCLIFFE-SMALL [Vacuum cleaners] 7,450/15; GRAHAM [Electric diaphragm sound-producing apparatus] 11,375/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Ignition: HEINS [Magneto] 17,191/15.

Switchgear, Fittings, &c.: GUTH [Lampholders] 11,723/15.

Application for Restoration of Lapsed Patent

Application has been made for the restoration of the following patent, which had lapsed through non-payment of renewal fees.

10,774/10. **Telephones.** N. BALDWIN. A telephone receiver with a light magnetic armature attached by a rod to a non-magnetic diaphragm.

The following are the more important patents that have become void through non-payment of renewal fees.

Arc Lamps, &c.: J. STEVENSON and O. R. WILLIAMS [Lamp suspension] 23,800/06.

Miscellaneous: B.T.-H. Co. [Control of watertight doors] 22,903/04; W. H. CHAPMAN [Discharging electricity from paper] 23,548/06; J. V. DAVIS and F. KENNEDY [Boot soles containing a primary battery] 23,500/07.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,482.

Give a rule for calculating the following windings: (*a*) for no-volt coils for use on A.C. switchgear; (*b*) solenoid-operated oil switches; (*c*) for use on brakes, &c. A frequency of 50 cycles to be assumed, but state what difference, if any, would be required for 60 cycles per sec.—W. E. L.

(Replies must be received not later than first post Thursday, February 24th.)

ANSWERS TO QUESTION No. 1,480.

I have two 11-kw., petrol-driven, 220-volt D.C. dynamos that were originally shunt wound, but have been converted to compound winding.

The machine voltage (by adjusting regulator) is 220 when supplying 25 amps., and this drops to 200 when current is increased to 30 amps., the speed of the machine remaining the same.

By increasing the brush lead (which should give a greater field demagnetisation), the trouble is remedied a little on full load; but when running on no load the machine generates 250 volts with the regulator all in.

The machines cannot be paralleled as it is found the volts vary so much with the slightest change in current, so that the machines readily motor—first one and then the other—as the regulators are altered to endeavour to divide the load.

What is the cause of these difficulties, and how can they be remedied?—"BOOSTER."

The first award is made to "Dynamo" for the following reply:—

The following seems to me to be a likely explanation of the phenomena described by "Booster":

When the dynamos were converted from shunt to compound, some of the shunt turns may have been removed to make room for the series winding, which was probably connected up in the wrong direction. This would account for the large drop produced when the current increases 5 amps., since the series winding will be subtracting its ampere turns, and thus tending to go on to the steep part of the magnetisation curve; hence the large drop—larger than would be the rise if the winding were correctly connected—and also the instability when machines are paralleled.

By increasing the brush lead the voltage is lowered and

is brought back to its correct value by decreasing the shunt resistance, thus bringing the machine farther away from the steep part of the curve, and consequently improving matters.

By removing some of the outer turns of the shunt coils the total number of turns is reduced, but the resistance of the coils is reduced in a greater proportion (because the outer turns are comparatively inefficient owing to their length), and therefore it is easy to get more ampere-turns with the same P.D. This account for 250 volts being obtained on one load. The remedy for the trouble is obviously to connect the series winding up in the right direction.

The second award is made to "W. H." for the following:—

It is very evident from the figures given that, when the machines were changed from shunt to compound wound, the series turns on the field were connected so as to give a differential effect instead of cumulative—*i.e.*, the field produced by the series turns opposes the field produced by the shunt turns; hence the reason for the voltage decreasing while the current increases.

This is also the reason why the generator cannot be run in parallel, as even if the machines are set at the same voltage on a certain load they will probably differ considerably in voltage at other loads.

The obvious remedy is to reverse the direction of current through the series turns by changing over the leads connected to those turns. A further improvement would be effected by fitting an equaliser connection by joining the end of the series field which is connected to the armature on one machine to the corresponding point on the other machine. This will give a better distribution of current between the two generators.

The probable reason for the high voltage obtained on no load, with the field rheostat all in, is that, instead of completely rewinding the field, the series turns have simply been wound on in addition to the original shunt.

If this is so, the only thing to do is to obtain a shunt rheostat with, say, 30 per cent. more resistance; this will allow of the voltage being reduced to something less than 200 on no load.

It is possible that a part of the original field rheostat has become shorted, but this is not likely to be the case with both machines.

Million-volt Transformer Experiments.—In our issue of December 9th, p. 491, we gave some particulars of the million-volt transformer which has been exhibited at the Panama-Pacific International Exposition at San Francisco. Some experiments with this transformer are now described in the American *Electrical Review and Western Electrician* by Mr. C. H. Thordarson. At the beginning of the experiments, he says, we tried to establish heavy arcs to ground without resistance or reactance in the circuit. This always failed; we were never able to establish an arc, but received intense discharges and terrific surges and dense corona along the high-tension wire that appeared from 8 to 10 inches in diameter. Judging from the destructive effect of these surges, they must have been equal to at least 2,250,000 volts. The circuit-breaker on the primary circuit at the sub-station was set at 300 amperes, 2,200 volts. It repeatedly opened during these experiments. These surges were quite uncomfortable; anyone standing on the ground within forty feet from the high-tension wires would feel his knees bend with every surge. Raising the hand in air, the finger-tips glowed and the air beat against the hand with each alternation, and felt as if the hand were held against a loosely clamped transformer core; in operation, the electrostatic field produced a loud hum in the air—the familiar note of the 60-cycle alternator.

The Artists' Rifles O.T.C.—This corps has a special class for training members who desire to obtain commissions in the Royal Engineers and Pioneer Battalions, and for testing candidates for such commissions. It is suggested that many men who have attested under Lord Derby's scheme might be glad to have this information, and to avail themselves of the facilities in preference to joining some Regular or Territorial unit.

Timber Drying.—Messrs. Joseph Owen & Sons, Ltd., of Liverpool, send us information concerning a system which it is claimed obviates the stocking of timber for prolonged periods for the purpose of seasoning. The system consists generally in placing the unseasoned timber in one or more large cylinders or chambers, and subjecting it to steam introduced into a cylinder, and a vacuum, or repetition of the steam and vacuum actions, which depends on the class of timber that is being treated.

ELECTRIC TRACTION NOTES

A long and valuable article on "Fundamental Principles of Car Operation Efficiency," by Mr. C. C. Chappelle, appears in the January 15th issue of the *Electric Railway Journal* of New York. The writer makes a study of the principles involved in the determination of the most economical rates of acceleration, braking, and speed, and of the inter-relations of the quantities which affect the economy of car operation. These relations are illustrated by some seventeen sets of diagrams of speed-time and energy curves from two typical railway companies, and as a result of an analysis of these the author derives certain interesting conclusions. The power input necessary to operate a given car, he says, at a given average speed, and with a given number of stops per mile, is solely dependent upon the efficient utilisation of the "time-element factors": acceleration, braking, and duration of stop. The effect on the power input of variation in these time-element factors is in proportion to the coasting time, and the increase in per cent. coasting is in proportion to decrease in per cent. energy consumption. Since efficient utilisation of power for given conditions is solely determined by these time-element factors, the correct method of checking the motorman's efficiency in the use of power is by a system giving him a positive, authentic record of his efficient utilisation of these factors, which, as explained, is measured by the coasting time and the per cent. coasting. The most economical schedule speed for given conditions is also dependent upon the efficient utilisation of the time-element factors, and to be economical the schedule must be such as to permit of coasting. The average number of stops per mile, considered in connection with the efficient utilisation of the time-element factors, determines the limitations of possible schedule speeds with a given equipment. It is therefore necessary, in determining the most economical schedule speed, to secure definite data in practical operation of the average number of stops per mile and the average duration of the stops.

The Swiss newspapers announced last week that it has been definitely decided to equip the Erstfeld-Bellinzona section of the Gotthard Railway on the single-phase system. Current will be supplied from power-houses at Amsteg and Ritom. The decision is based largely on the success of the Lötschberg line, and it is anticipated that the single-phase system will also be used on the other sections of the Gotthard Railway as they are successively electrified, and also on all future electrifications of Swiss railways. The two power-houses at Amsteg and Ritom will be so designed as to be capable ultimately of supplying the whole Gotthard line from Lucerne to Chiasso.

According to the *Pall Mall Gazette*, the work of electrifying the North London Railway to Richmond will shortly be commenced.

The Institution and Research.—The Council of the Institution has been informed by the Committee of the Privy Council for scientific and industrial research that the following grants have been made to the Institution for one year's research, viz.:—Heating of buried cables, £840; properties of insulating oils, £250. The result of the application made by the Council in connection with seven of the researches (Electrical Engineering, Dec. 9th, 1915, p. 491) has not yet been made known.

Insurance of Diesel Engines.—The Diesel Engine Users' Association has for some time been endeavouring to obtain more satisfactory terms for insurance of Diesel engines, and we have now received particulars of a scheme whereby Messrs. Mirrlees, Bickerton & Day, Ltd., have made arrangements with the London Guarantee & Accident Co. for insuring Diesel engines of this firm's make, one of the advantages being periodical inspection and examination by members of Messrs. Mirrlees, Bickerton & Day's staff. The policy not only covers damage to the engine proper together with its accessories, but also to surrounding property.

Pressure Testing Stations.—We recently recorded a suggestion from the Hackney Borough Council that the L.C.C. should suspend, during the period of the war, the periodical inspection of the various Borough Councils' electricity pressure testing stations, but the L.C.C. has intimated that it cannot see its way to do this.

Prohibited Exports.—An Order in Council was issued on Saturday prohibiting the exportation of carbon electrodes for electric furnaces.

THE INSTITUTION AND THE FORCES

WE give below the sixth list of members of the Institution of Electrical Engineers who are serving with H.M. Forces. Previous lists appeared in ELECTRICAL ENGINEERING for January 21st, February 18th, March 4th, and July 15th, 1915, January 6th, and February 10th, 1916:—

Members.—Lieut. C. Barber, R.F.C.; Col. R. E. Crompton, C.B., R.E.; Col. P. B. Crowe, Lines of Communication; 2nd Lieut. W. S. Lonsdale, R.E.; Lieut. F. H. Michell, South African Engineers; 1st Class Petty Officer E. E. Moore, Anti-Aircraft Corps, R.N.A.S.; Col. W. Standford, D.S.O., Cape Peninsula Convalescent Homes.

Associate Members.—2nd Lieut. A. M. Anderson, R.E.; Capt. H. Bailey, 2/4th East Lancashire Regt.; L. W. Ballard, London Elec. Eng., R.E.; Corporal C. G. Barker, A.S.C.; Lieut. J. Barnard, A.O.D.; 2nd Lieut. E. J. L. Bennett, R.F.A. 2nd Lieut. C. C. Berger, Home Counties Divisional R.E.; 2nd Lieut. E. T. Caparn, R.E.; 2nd Corpl. V. A. Cornelius, London Elec. Eng., R.E.; A. A. Davis, South African Overseas Force; 2nd Lieut. R. S. Dolleymore, A.S.C.; N. Donkersley, R.A.M.C.; 2nd Lieut F. T. C. Emberton, R.E.; 2nd Lieut. E. W. P. Fulcher, R.E.; 2nd Lieut. F. W. Gaskins, West Riding Divisional R.E.; 2nd Lieut. W. A. Hatch, R.E.; Lieut. J. A. Hunn, R.N.V.R.; 2nd Lieut. G. Jacques, R.F.C.; R. K. Keer, London Elec. Eng., R.E.; Lieut. K. W. Klitz, A.O.D.; 2nd Lieut. G. J. MacDonald, Hampshire (Fortress) R.E.; Lieut. G. Montague, A.S.C.; 2nd Lieut. T. R. Overton, 4th Maori Contingent; P.O. J. H. Pattman, R.N.A.S.; Assistant Inspector N. V. Raven, Inspection Staff; Capt. R. K. Rice, R.N.; 2nd Lieut. J. D. Ross, London Elec. Eng., R.E.; 2nd Lieut. F. E. Saunders, R.E.; A. J. Smith, R.N.; 2nd Lieut. R. M. Smith, R.E.; Sergeant J. P. Strange, London Elec. Eng., R.E.; C. E. Stuart, R.F.C.; Lieut. A. C. Timmis, R.E.; R. O. Udall, 2nd Canadian Pioneer Battalion; Sub-Lieut. N. Wells, R.N.V.R.

Associate.—W. S. Tucker, London Elec. Eng., R.E.

Students.—E. Braathen, R.F.C.; Lieut. J. P. Castle, 3/2nd London Divisional R.E.; D. S. Charles, Artists' Rifles O.T.C.; G. Collyer, London Elec. Eng., R.E.; C. D. Farmer, London University O.T.C.; A. Harrison, R.N.V.R.; L. J. Jones, R.F.C.; 2nd Lieut H. J. McKenzie, R.F.C.; W. Palmer, Artists' Rifles O.T.C.; D. G. B. Partridge, London Elec. Eng., R.E.; 2nd Lieut. H. S. Ripley, Tyne Elec. Eng., R.E.; W. L. A. Rogers, London Elec. Eng., R.E.; 2nd Lieut. G. M. Ross, R.E.; Lieut. T. M. Ryan, R.E.; Lieut. G. J. Scott, 4th Artillery Training School (T.F.); D. H. Simmonds, R.N.A.S.; Lance-Corpl. F. Smethurst, 1/8th Essex Regt.; Sub-Lieut. F. C. Topham, R.N.V.R.; Lance-Corpl. J. S. Walker, A.S.C.; T. L. Wenger, Artists' Rifles O.T.C.; Corporal J. S. Whitney, R.E.; E. W. Workman, London Elec. Eng., R.E.

The following is an additional list of promotions, transfers, &c.:—

Members.—Capt. R. L. Alkin, 4th East Lancashire Regt; Major H. Bell, 1/3rd Northumbrian R.E.; Lieut. J. Caldwell, 3/6th Argyll and Sutherland Highlanders; Capt. R. K. Morcom, Divisional Engineers, R.N.D.; Capt. H. C. Sparks, London Scottish; Major C. S. Stafford, Canadian A.S.C.; Lieut. T. M. W. Wallis, R.N.V.R.

Associate Members.—Lieut. A. R. Alderson, R.E.; Sergeant G. C. Allingham, Divisional Engineers, R.N.D.; Lieut.-Com. E. G. Boissier, R.N.D.; Lieut. W. Brown, R.E.; Lieut. V. O. Davis, R.E.; 2nd Lieut. T. F. Dillon, R.E.; 2nd Lieut. E. J. Dutch, 14th Royal Fusiliers; Lieut. G. B. Dyke, R.G.A.; 2nd Lieut. D. Harrop, 12th Loyal North Lancashire Regt.; Capt. C. Higgins, London Divisional R.E.; Capt. A. H. Huddart, A.S.C.; 2nd Lieut. L. E. S. Jackson, 2nd London Brigade, R.F.A.; Lieut.-Col. A. B. Layton, South Lancashire Regt.; Capt. S. M. Mohr, 12th Notts and Derby Regt.; Warrant Officer G. D. Nelson, R.N.A.S.; Lieut. R. S. Newton, East Lancashire R.E.; Lieut. L. Roseveare, R.G.A.; Lance-Corpl. C. W. Salt, London Elec. Eng., R.E.; 2nd Lieut. L. F. Summers, A.S.C.; Capt. H. C. Symmes, 2nd South African Infantry; 2nd Lieut. T. S. Wallis, R.E.; Lieut. W. H. Walton, R.N.V.R.; Lieut. A. G. Watson, R.N.V.R.; Capt. S. Utting, A.S.C.

Associates.—Capt. P. H. Marco, 13th York and Lancaster Regt.; Lieut. C. G. Wells, R.E.

Students.—Lieut. J. R. Abbott, Tyne Elec. Eng., R.E.; Flight Sub-Lieut. T. C. Angus, R.N.A.S.; Eng. Lieut. E. E. Birch, R.N.R.; 2nd Lieut. C. S. Coombs, 6th Royal West Kent Regt.; Lieut. J. G. Deedes, London Signal Service, R.E.; 2nd Lieut. P. Dobie, R.E.; Sub-Lieut. M. O. F. England, R.N.A.S.; Lieut. B. Z. de Ferranti, Royal Garrison Artillery; Lieut. R. Frube-Sutcliffe, East Lancashire Divisional R.E.; Lieut. D. C. Goodswin, 2nd London Divisional R.E.; Driver L. A. Gripper, British Red Cross; Lance-Corpl. R. W. Harrison, London Elec. Eng., R.E.; 2nd Lieut. A. D. Hedgcock, London Elec. Eng., R.E.; Lieut. J. A. B. Hellaby, R.E.; Lieut. S. G. Killingback, London Divisional R.E.; 2nd Class Warrant Officer V. H. M. McMahon, A.S.C.; Lieut. G. S. Marston, R.E.; Sergeant N. H. Miller, R.E.; 2nd Lieut. C. I. Morris, 12th Royal Warwickshire Regt.; 2nd Lieut. W. H. Norburn, Hampshire (Fortress) R.E.; Lieut. L. H. Peter, Cornwall (Fortress) R.E.; Lieut. R. N. L. Protheroe, R.F.A.; Lieut. S. E. T. Pryce, R.G.A.; 2nd Lieut. C. E. Tolley, 3/1st Northumbrian Divisional R.E.; 2nd Lieut. R. I. Wells, 3rd South Staffordshire Regt.; Corporal C. S. Williams, Divisional Engineers, R.N.D.

THE ORGANISATION OF SCIENTIFIC RESEARCH

DR. J. A. FLEMING, F.R.S., is one of the foremost in that band of leading men of science who have been trying with great perseverance to educate public opinion on the national importance of the organisation of scientific research, and his Paper on this subject, read before the Royal Society of Arts on Feb. 9th, together with the discussion following it, deserve a wide publication. Amongst the indirect results of this appalling war, said Dr. Fleming, we may hope there will be some increased appreciation in the minds of the politicians who govern us of the enormous influence of scientific research and discovery, even in its most abstruse forms, on the prosperity and safety of the Empire. It must be recognised, however, that there are no short cuts to great national achievements in scientific work; we cannot produce merely the knowledge which is instantly utilisable in common life. Just as we can only convert a part of any quantity of heat into mechanical work, so we cannot convert the whole of any scientific knowledge into useful applications; we have to create that knowledge disinterestedly, and then some applications will follow. A point seems to have now been reached at which the first attempt to organise research should be to create something more resembling an army out of the multitude of independent scientific workers. This means that young investigators, and even older ones, shall be content to take up pieces of prescribed work and carry it out in connection with certain large plans of operation. The White Paper issued last July by the Board of Education seems intended to bring into existence some machinery for effecting the desired end. This White Paper proposes that the "advisory council" which is contemplated shall work largely through sub-committees reinforced by suitable experts. Separate bodies of experts will unquestionably be required to deal with the different subjects, but why is it necessary to create a new machinery for dealing with these matters? The organisation of scientific research should not become bureaucratic or academic; it should be the work of scientific men as a whole, and not any small section of them, or be carried out by Departmental officials over their heads.

There are the learned societies, such as the Physical and Chemical Societies, the Society of Chemical Industry, the Institute of Chemistry, Faraday Society, the Institutions of Civil, Mechanical, and Electrical Engineers, and so on—why not let each of these form a strong but small research committee of their most eminent original investigators? This selection should be determined by the votes of all the members, and regard should be taken of nothing but real, originative ability, as exhibited by past achievements. The Royal Society might put itself at the head of this work. The first work of such committees should be to draw up a report pointing out the general needs of each department of knowledge and the most necessary directions of research in it.

The granting of scholarships on the lines of the 1851 Exhibition scholarships was advocated, which should be of the value of £150 to £200 a year or more. Last May a deputation of the Royal and Chemical Societies waited upon the Board of Education, and later on it was announced that a Parliamentary grant of £25,000 per annum would be placed at the disposal of the Board for the purpose of research. The nation ought to be prepared, however, to expend at least the cost of one battleship in the defence of our scientific industries.

The Institution and Enemy Members.—With further reference to the Note on page 50 of our last issue in connection with the expulsion of enemy members of the Institution of Electrical Engineers, a special general meeting will be held at the Institution on March 1st, at 5 p.m., for the purpose of considering, and if thought fit, of passing the following addition to Article 41 of the Articles of Association:—

In the event of a state of war arising between the United Kingdom of Great Britain and Ireland and any other country or State, any member of any class who at any time during such war shall be a subject of such enemy country or State shall forthwith cease to be a member of the Institution, and in the case of the European War of 1914 all such members shall cease to be members of the Institution on and after the 16th day of March, 1916.

A confirmatory meeting will be held on Thursday, March 16th, at 7.50 p.m.

Faraday House Journal.—The journal of the Electrical Standardising, Testing & Training Institution (Faraday House) for the Lent term contains as a frontispiece a portrait of Mr. C. P. Sparks, President of the Institution of Electrical Engineers, and senior past-President of the Faraday House Old Students' Association. A list of past and present students serving with the forces is brought up to date, and there are two pages of photographs in this connection.

LOCAL NOTES

Birmingham: *Coal Contracts.*—It is stated that the Electric Supply and Gas Committees have decided to pool their contracts for coal in future. This suggestion has been made at the annual conventions of the I.M.E.A., and there is little doubt that if it can be adopted throughout the country, considerable savings would be effected.

Chelmsford: *Street Lighting.*—The Town Council is having a little dispute with the Electric Supply Corporation as to the rebate which should be allowed upon the street lighting account, having regard to the fact that the lighting is very much reduced under the Defence of the Realm Act. The Electric Supply Corporation has offered a reduction of £700 per annum from the usual amount, which, however, is not acceptable by the Council. An endeavour is being made to come to an agreement on the basis of the Council's terms with an extension of the street lighting to other parts of the borough after March 31st, when the present contract expires.

Dublin: *An Apology.*—We regret that the note published in our last issue, stating that a slander action was pending against the City Electrical Engineer of Dublin, was published in error, and is entirely without foundation. We desire to apologise to the City Electrical Engineer of Dublin for any inconvenience that may have been caused to him by the publication of the statement in question.

London: *Marylebone: Apprenticeship Scheme.*—The scheme of apprenticeship in the Electricity Department sanctioned by the Council in our issue of October 14th, 1915, on page 422, has now progressed, and specimen copies of the proposed entries have been placed before the Council. The remuneration is to commence at 5s. per week for the first year, rising to 20s. per week at the end of the apprenticeship period, no premium, of course, being asked.

Lowestoft: *Electricity Accounts.*—The report of the Electricity Department for the past year shows a deficiency of £2,275. This poor result is attributed to the increased cost of coal and other materials, whilst it has been found impossible to reduce working expenses below the present figure. There was actually a loss of revenue of £4,107 compared with the previous twelve months.

Manchester: *Air Raid Warning.*—The Electricity Department has issued a warning to consumers that in the event of air raids in future the impending interruption to the supply of electrical energy will be signalled by alternatively raising and lowering the pressure of the whole system several times for a period of five or ten minutes before the complete shutting down of the power-houses.

Surbiton: *Transfer of Electricity Undertaking.*—The Board of Trade has sanctioned the transfer of the electricity undertaking to Messrs. Callenders Cable Co. Hitherto the company has worked the undertaking on behalf of the Council.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Accrington.—A scheme for reorganising the boiler plant at the destructor works, used in conjunction with the electricity works, is in course of preparation at an estimated cost of between £5,000 and £6,000.

Australia.—The Metropolitan Board of Water Supply, Sydney, requires two 300-kw. turbo-alternators, with exciters, condensers, switchboard, &c. Further particulars at 73 Basinghall Street, E.C. May 1st. This information is only of use to firms who can cable agents.

Barrow.—A loan of £10,300 is to be applied for to meet the increasing demand upon the electricity undertaking.

Birkenhead.—An application is to be made for a loan of £6,400 for high-tension plant, mains, &c.

Chesterfield.—The Local Government Board have sanctioned a loan of £1,800 for plant extensions.

Manchester.—A loan of £40,000 for hiring out motors and for plant at the distributing stations in contemplated.

Pembroke (Ireland).—A Local Government Board inquiry has been held concerning a loan of £15,000 for new plant.

Stafford.—An application is to be made for a loan of £12,000 for new plant.

Miscellaneous

Dundee.—The Tramways Committee require a twelve months' supply of lamps, switches, and other sundries. General Manager. Feb. 28th.

New Zealand.—The Dunedin Council requires six complete electric tramway cars. Town Clerk. May 17th. This information is only of use to firms who can cable agents. Further particulars at 73 Basinghall Street, E.C.

South Wales.—The Bedwas Navigation Co. requires a twelve months' supply of electrical goods. Secretary.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £135 to £138 (last week, £130 to £132).

Electrical Supplies Co., Manchester Branch.—In order to meet the increasing demands of customers in Manchester and district, the Electrical Supplies Co., "The Light House," 233 Tottenham Court Road, London, W., have decided to open a Manchester office and stores at No. 40 Victoria Buildings, Victoria Street, Manchester (Telephone No., City 5794). Mr. R. L. Bateson has been appointed Manager of this branch depôt, and it is the intention to hold stocks of all the standard electrical supplies. Considerable extensions have been made in the firm's fittings and electric heating and cooking departments and motor and dynamo departments.

Liquidations.—A meeting of the creditors of the Automatic Electric Block Signalling Co., Ltd., has been held. Particulars of claims should be sent to Arthur Colls, liquidator, at 12 Victoria Street, Westminster.—The first meeting of creditors of the Adnil Electric Co., Ltd., will be held at 33 Carey Street, London, W.C., on the 29th inst., at 11.30 a.m.

Agencies.—The British Chamber of Commerce at Genoa states that a firm at Bari desires to represent United Kingdom manufacturers of electrical plant. Further particulars at 73 Basinghall Street.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

London Supply Companies' Dividends.—A number of London electric supply companies have either published their accounts or declared their dividends for 1915, and a comparison of the figures with those for 1914, which was only partly a war year, is interesting. The St. James's & Pall Mall Electrical Light Co. is only able to declare 8 per cent. for the year, against 10 per cent. in 1914, and the Westminster Electric Supply Corporation is similarly down by 2 per cent., the respective figures being 7 and 9 per cent. The Chelsea Co.'s dividend is at the rate of 4 per cent. per annum, as against 5 per cent. in 1914. These decreased dividends are notwithstanding increases in the charges to consumers.

Yorkshire Electric Power Co.—The net profit for 1915 was £21,209, against £20,535 in the previous twelve months. A 1 per cent. dividend is recommended on the ordinary shares, as against 2 per cent. in 1914, £7,500 is transferred to the general reserve, and £2,478 carried forward

Arrangements for the Week.—(*To-day*) *Thursday, Feb. 17th.*—Institution of Electrical Engineers. The Seventh Kelvin Lecture. "Terrestrial Magnetism," by Dr. C. Chree. 8 p.m.

Tuesday, Feb. 22nd.—Manchester Section, I.E.E. Engineers' Club, Albert Square. "Continuous-Current Railway Motors," by E. V. Pannell, 7.30 p.m.

Illuminating Engineering Society at Royal Society of Arts, John Street, Adelphi. "Some Future Possibilities in the Design of Instruments for Measuring Illumination," 8 p.m.

Wednesday, Feb. 23rd.—Birmingham Section, I.E.E. At the University. Kelvin Lecture on "Terrestrial Magnetism," by Dr. Charles Chree, F.R.S., 7 p.m.

Liverpool Engineering Society. At the University. "Efficiency of Projectors and Reflectors." by Haydn T. Harrison.

Diesel Engine Users' Association. At I.E.E., Victoria Embankment.

Friday, Feb. 25th.—Batti-Wallahs Society. Informal meeting and concert at Victoria Mansions Restaurant, Victoria Street, S.W., 6 for 6.30 p.m.

ELECTRICAL ENGINEERING

With which is Incorporated

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SUMMARY

Germany's use of zinc in place of copper for cables, transformers, and even dynamos and motors, is of particular interest. Official regulations and standards have been issued, and also a long official memorandum to warn users of the various precautions to be taken. The numerous difficulties are instructive and some of the remedies entertaining. Iron commutators and slip-rings are also recommended (p. 64).

The Diesel Engine Users' Association explain their insurance scheme (p. 64).

We give reasons against a general switching off of electricity supply on the receipt of Zeppelin warnings, and also discuss the advisability of employing search-lights in a systematic manner in conjunction with aeroplanes for defensive purposes (p. 65).

Among the subjects of specifications published last Thursday at the Patent Office were telephone cables, electric trucks, carbon electrodes, and telegraphy. Amendments have been allowed in a patent relating to the electrolytic production of zinc and a wireless telegraph patent is opposed. Patents in connection with arc lamps and motors expire this week after a full life of fourteen years (p. 66).

Our Questions and Answers page this week deals with methods of wiring an indicator lamp to show whether all the lights in a warehouse are turned off (p. 67).

Some particulars as to the position with regard to the cable contracts for the L.B. & S.C. Railway extensions are given. The transmission pressure to the sub-stations will be 60,000 volts and the actual potential of each main 30,000 volts.—The choice of the high tension overhead A.C. system for the Philadelphia electrification is discussed (p. 68).

We refer to some of the causes of reduced dividends of London Electric Supply Co.s (p. 68).

We give descriptions of a drawing office lighting installation, a shell inspection lamp, and a new type of electric fire (p. 69).

The Brighton Corporation has abolished the maximum demand system.—The scheme for training women electricians has been voted upon adversely at Liverpool (p. 70).

A large number of authorities require electrical stores; an 11,000-volt cable is required at Kilmarnock, and water power electric plant in Australia (p. 70).

Regular readers of "Electrical Engineering" should now ORDER their copies from their newsagents or at the bookstals, at which they customarily buy their weekly copies.

The Government has decided that strict economy in paper is necessary and, in consequence, to prevent waste, the majority of newsagents and bookstalls will limit their stocks so far as possible to the actual known requirements of their customers. A mere verbal order will, however, be sufficient to ensure that a copy is sent or reserved weekly.

"Electrical Engineering" can also be sent direct to readers by post. Copies are posted on Wednesday evening, and should reach readers in practically every part of the United Kingdom on Thursday (in London, and many other towns, by first post). Orders, with a remittance of 6s. 6d. for one year, 3s. 3d. for six months, or 1s. 8d. for three months, which includes postage (Colonies and Abroad 8s. 8d. per annum), should be sent to the Kilowatt Publishing Co., Ltd., 203, Temple Chambers, London, E.C.

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

(To-day) Thurs., Feb. 24th: Shooting for Sections I. and II., and signalling class.

Fri., Feb. 25th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Feb. 26th: Uniform parade, 2.45 p.m.

Mon., Feb. 28th: Sections I. and II., technical. Sections III. and IV., lashings and trestle bridging. Signalling class and recruits.

Tues., Feb. 29th: School of Arms, 6 to 7 p.m.

Thurs., Mar. 2nd: Shooting for Sections III. and IV.

Fri., Mar. 3rd: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Mar. 4th: Adjutant's instructions class at 2.30 p.m.

Sections for technical parade at Headquarters, London Electrical Engineers, 45 Regency Street, S.W.

Sections for shooting parade at miniature ranges.

Unless otherwise ordered, all parades at Chester House.

(For "Arrangements for the Week" see p. 65.)

GERMANY'S ZINC

WE have already published articles and notes regarding the systematic use of zinc and iron in Germany in place of copper (see ELECTRICAL ENGINEERING, May 27th, Oct. 14th, and Oct. 28th). Zinc cables insulated with reclaimed rubber are now standard in that country, as is also iron "flex," and these two metals are regularly employed for bearing "brasses," terminals, switchboard 'bus-bars and cable lugs, switches and switchgear, plugs, fuse-holders, lampholders, and even lamp-caps. During the past three months several articles have been published in the *Elektrotechnische Zeitschrift* with regard to the use of these metals, particularly zinc. In December the Verband Deutscher Elektrotechniker found it necessary to issue a lengthy memorandum in order to clear up the incorrect views which still existed in the minds of many users as to the properties of zinc as a conductor, the fiction being maintained that the difficulties in manufacture have been largely overcome.

The user is first reminded that the conductivity of zinc is only 28·5 per cent. that of copper (iron 12·5 that of copper). Zinc is tricky as to its flexibility, and different samples vary considerably. It has been ascertained, however, that heating over 100° C., especially for fairly long periods, may cause serious deterioration in its mechanical properties and make it quite brittle, and when it is heated in moist atmosphere corrosion is certain to occur. Extreme care is necessary in bending zinc wire round terminals, &c., while, on the other hand, soldering is to be avoided on account of the high temperature, yet the use of cable lugs is recommended. It is difficult to see how the cable user is to steer a straight course through these contradictory recommendations, but further difficulties are immediately mentioned. Zinc cable is to be bent with great care, and on no account more sharply than round a radius of twenty-five times the diameter of the cable (and, of course, owing to its poorer conductivity, the diameter will be much bigger than the corresponding copper cable). If laid in frosty weather the cable is first to be warmed, and cable already laid must not be moved or subjected to any mechanical stress in frosty weather. In sweating on the terminal lugs the temperature of the solder used as filling must only slightly exceed 100° C. (!), and the zinc must not be heated with a blow-lamp. So some sort of screwed-on cable lugs are to be preferred, and if these are made of other metal than zinc (and somehow we cannot conceive even an official-regulation-loving German having a partiality to zinc screws) they are to be protected from moisture and consequent electrolytic action.

In calculating the load to be carried by a zinc cable, a 25° C. rise in temperature is to be considered the maximum allowable, as in the case of copper cables according to German standards. A convenient rough rule is given that for the same rise in temperature zinc will carry just about half the current as copper of the same section. The melting point of zinc is 412° C., as against 1,084° C. for copper, but this is compensated by the larger mass of metal required for the same conductance.

It is recommended that zinc cables should not be employed of less section than 16 sq. mm., and that, even for this size cable, stranded conductors should be employed so that a single brittle place in the wire does not cause a complete break. Pilot wires in zinc cables are not recommended, as they would probably break in laying.

For overhead lines zinc cable is not considered suitable owing to the mechanically weak places that are bound to occur in the wire, especially when exposed to the atmosphere.

The week after the above memorandum was issued another special notice of the Verband Deutscher Elektrotechniker appeared in the same journal, giving a very complete table of the permissible loads for underground zinc cables, and, instead of 16 sq. mm. being taken as the minimum section, as above indicated, the table starts at 1 sq. mm., which is permitted for single cables carrying 12 amperes at 750 volts, twin cables carrying 10 amperes up to 3,000 volts, and three-core cables carrying 9 amperes. Concentric cables are allowed from 10 sq. mm. up to 400 sq. mm.

The next official communication from the Verband, published on Dec. 30th, pointed out that the windings of many electrical machines and transformers could well be of zinc wire, and slip-rings and commutators of iron. It was somewhat ingenuously added that "as, up to the present, there is no very long experience with such machines, no guarantee of complete certainty of operation can be expected from the manufacturers," and that they must therefore not be employed in cases where the possibility of failure is to be absolutely excluded. Nor may they be used for any special machines or when exposed to high or low temperatures or used out-of-doors, and machines with iron commutators require particularly careful attendance. The capacity of machines and transformers with zinc windings, the note goes on to say, will be lowered, and in consequence they will cost a higher price than when made in the ordinary manner. A list of capacities suitable for zinc windings follows. This includes transformers for any voltage from 130 to 30,000 and up to 250-k.v.a. capacity for three-phase, and 166 for single-phase; the small capacities are excluded, however—for instance, the minimum for a 2,000-volt zinc winding is 2 k.v.a. three-phase, and 1·3 k.v.a. single-phase. Single- and three-phase generators and synchronous motors with fixed armatures and rotating fields may have both windings of zinc, up to 150 k.v.a. for three-phase and 100 k.v.a. for single-phase, and at 375 to 1,000 r.p.m. (the exciters, if direct-coupled, must generally have copper windings, otherwise their capacity will be insufficient). Fifty-cycle three-phase motors may have both rotor and stator windings of zinc for speeds from 375 to 1,500 r.p.m., pressures up to 5,000 volts, and capacities from 3·7 to 100 kw. The following D.C. machines are recommended to have copper armature windings, zinc field windings, and iron commutators:—100 to 260 volts, 2 to 250 kw., and 260 to 550 volts, 6 to 400 kw. This assumes a speed of 1,000 r.p.m.; if for different speeds, the capacities to apply must be varied proportionately to the speed, but for too high speeds iron commutators must not be used.

On Jan. 6th an article by Leon Lichtenstein was published with a view to meeting further objections to the use of zinc cables. It appears that the impression had gained ground that a short on a zinc cable would result in a considerable length of the cable being melted or reduced to powder. The author takes considerable trouble to calculate that there is no more danger of melting in these circumstances than with copper, and experiments were also made to show that, although the mechanical strength of zinc wire is greatly diminished by heating to high temperature, there was no question of the metal being disintegrated.

Notwithstanding all these official memoranda and articles, there is no doubt that the electrical industry in Germany is being very seriously affected by the copper shortage. The use of zinc in place of copper is obviously a poor makeshift, but it is apparently the only way at present devised to get out of the difficulty.

CORRESPONDENCE

INSURANCE OF DIESEL ENGINES AGAINST BREAKDOWN.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—In your issue of 17th inst. you make the announcement that the Diesel Engine Users Association have for some time past been endeavouring to obtain more satisfactory terms in connection with insurance of Diesel engines against breakdown, and your note would seem to imply that, as a consequence, a new scheme of insurance has been put forward with the approval and support of this Association. The new scheme referred to is confined to the engines of one particular firm of manufacturers, and it provides for the inspections to be carried out by the engineers of the manufacturing firm itself. No such scheme has been adopted by this Association, and the use of our name in connection therewith is quite unauthorised.

About a year ago this Association carefully considered and adopted a standard form of policy for insurance of Diesel engines against breakdown, and satisfactory arrangements were made under which such insurance could be effected on favourable terms by Lloyd's underwriters. It was arranged that specially advantageous terms should be granted to the firms or undertakings with which the members of the Association are connected, the underwriters recognising that the interchange of information and the collection and communication of data among the members of the Association was conducive to the reduction of troubles and risk from breakdown. A very important feature of the scheme of insurance which has been adopted by this Association is that the inspections and reports are made by well qualified and *independent* experts unconnected in any way with any particular firm of manufacturers.

Yours faithfully,

PERCY STILL,

Hon. Secretary, Diesel Engine Users Association.

19 Cadogan Gardens, S.W., Feb. 21st, 1916.

ZEPPELINS AND LIGHT

IN the early days of the war, when precautions against Zeppelin raids were being increased, the suggestion was made that, on the threat of a raid, all electric lighting stations should immediately switch off current. It seemed probable then that this proposal would carry weight with the Government, and we published a strong article calling attention to the dangers which would be incurred by such a course. To plunge the streets suddenly into absolute darkness in a city full of traffic would be in itself sufficient to cause more casualties than any to be anticipated from the dropping of bombs, but added to this would be the risk of panic in theatres, music halls, etc., and last, but not least, danger to life in hospitals. The sudden extinguishing of the light in an operating theatre would in many cases result in the death of the patient. There were other reasons also, which would weigh with the authority charged with the defence of London, to make the switching off of the supply of current inexpedient, and instructions were issued to the supply companies not to switch off, but, on the contrary, to maintain the supply at all costs.

It seems that the same agitation for switching off is now taking place in the Midlands, but we trust that for reasons of public safety and the avoidance of panic the proposal will not take effect. In the larger towns similar dangers would be incurred as in London. To plunge the centres of traffic in such towns as Birmingham or Manchester suddenly into utter darkness would be the immediate cause of numerous accidents, and the rush of crowds to get out of theatres and public buildings into absolutely dark streets would be attended with serious results, the more so as the stoppage of the trams (which in any case must certainly be done owing to the flashes on the trolley wires) would add to the confusion and the congestion of street traffic. Moreover, the sudden stoppage of works driven by electricity would introduce further risks. The suggestion that a warning should first be given by, say, three short interruptions in the supply overlooks the fact that the works would virtually be shut down entirely automatically on the first of such warnings due to the action of the no-voltage releases in the motor circuits.

The time taken for aircraft to reach the Midland towns from the coast is far longer than that required to reach London, and, assuming the fastest speed and direct routes, there is plenty of time for warnings to be received and lights to be partially extinguished in conformity with a pre-arranged programme long before these towns are threatened. To speak of delay owing to the congestion of trunk telephone lines by private conversations is absurd; the trunk lines are always at the disposal of the Government, and the operators must by now be well accustomed to give Service messages precedence.

It is not within our province to discuss the reasons of the unpreparedness of the country generally to repel Zeppelin attacks; enough—perhaps too much—has already been published in the daily papers on this subject generally. The statements made in Parliament, however, have made clear that, although London may be well furnished with anti-aircraft guns, and although those on the coast may not all be of the nature of war relics, as stated by Mr. Joynson Hicks last week, we must rely on aeroplanes and not guns for our main defence elsewhere. Now it is generally recognised that these "swarms of hornets" are not night insects, although, given light, even a single aeroplane can be a match for a Zeppelin. To quote Lanchester's excellent book just published ("Aircraft in Warfare," by F. W. Lanchester. Constable and Co., Ltd., 1916. 12s. 6d. net):

It is evident that the weak point of any dirigible or airship is its liability to attack from above . . . in the case of the rigid type—such as the Zeppelin—the structure would not stand up under a blow from, say, a steel bar of an ordinary stock section of 70 lb. or 80 lb. weight dropped from a height of 200 or 300 feet. Without saying that the above are suitable methods of attack, it may be claimed that they fairly indicate the inherent weakness of the dirigible. . . . It may escape for a time, and may render a certain amount of useful service, but only thanks to the circumstance the number of 'high-powered, fast-climbing aeroplanes is comparatively limited, and to the fact that scientific methods of attack have not yet been fully worked out or put into practice. However, even to-day, the finest of Germany's fleet of Zeppelins would be absolutely at the mercy of a modern aeroplane in the hands of a man prepared to make his one and last sacrifice [that of ramming it from above].

A Zeppelin, therefore, with its length of over 400 ft., should certainly be fairly easy prey for a comparatively small fleet of aeroplanes if they can see it and if they have sufficient light to rise in safety. The light for both purposes can obviously be provided by searchlights, with the usual concentrated beam for the former purpose and a diffused beam for the latter. Searchlights for anti-aircraft defence need not be regarded purely as accessories to guns; they can be of equal use as necessary auxiliaries to night attack by aeroplanes, and they can be constructed and mounted in a comparatively short time—measured in weeks, not months. If defence by aeroplanes is to be perfected, the course to be pursued should be for the aeroplanes to rise from well-lighted aerodromes inland as soon as the warning of the approach of Zeppelins is received from the coast—that is to say, sufficiently early for these not to afford a beacon to the enemy. They can then proceed to those places which the Zeppelins will make their main objective, and near which lines or rings of searchlights of long range and high penetrative power should have been erected. If, in consequence, the Zeppelins steer clear of these points, the defence has been adequate. If, on the other hand, they make for them, relying on the searchlights to direct them as soon as they come within ear-shot, the aeroplanes will have their chance.

There is, it is true, one risk in following the above scheme of defence. If the lights have insufficient power, they will act as beacons for the enemy and yet not illuminate the hostile aircraft sufficiently for efficient attack. The avoidance of this risk is, however, merely a question of mirror diameter and amperes. If the War Office need guidance on these points we shall be happy to give it, but even if the risk were serious, surely the Englishman would sooner incur it than trust to primæval darkness and chance for his security.

Arrangements for the Week.—*Friday, Feb.* 25*th*.—Batti-Wallahs Society. Informal meeting and concert at Victoria Mansions Restaurant, Victoria Street, S.W., 6 for 6.30 p.m.

Tuesday, Feb. 29*th*.—Association of Supervising Electricians, St. Bride's Institute, Fleet Street, E.C. "Illuminating Engineering," by L. Gaster. 7.15 p.m.

Wednesday, March 1*st*.—Institution of Electrical Engineers. Special General Meeting *re* alteration to Articles of Association to deal with enemy members. 5 p.m.

Institution of Electrical Engineers, Students' Section. Discussion on "Suggested Applications of Science to Warfare." Opened by R. E. Dickinson. 7.45 p.m.

Friday, Mar. 3*rd*.—Evening discussion by Prof. S. P. Thompson, F.R.S. "Corona and other Forms of Electric Discharge." 5.30 p.m.

Saturday, Feb. 26*th*.—Association of Mining Electrical Engineers, Notts and Derbyshire Branch. University College, Nottingham. "Static Transformers," by Chris Jones. 3.30 p.m.

Junior Institution of Engineers. Bohemian Concert in aid of the British Red Cross Society. Holborn Restaurant, 3 p.m.

Train Lighting.—Referring to the Jarrow accident at the annual meeting of the North Eastern Railway Co., on Friday, Lord Knaresborough, chairman, said that the question of carriage lighting had on several occasions engaged the attention of the directors during the last few years, and all new stock, as well as the East Coast Joint stock, had been fitted with electric lighting. The whole question was again being carefully considered in the light of the evidence at the Jarrow inquest.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Feb. 17th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

1,346/15. **Telephone Cables.** K. W. WAGNER. Insulating materials, such as "gutta-gentzsch," containing little resinous matter, are used instead of gutta-percha in cables for loaded telephone circuits to reduce the dielectric loss and thereby reduce the damping.

1,582/15. **Electric Trucks.** P. A. MOSSAY. A three-wheeled electrically-driven truck for railway-platform and similar work with a front steering and driving wheel on a fixed axis, the front axle being connected by a frame additional to the chassis carrying the load. (One figure.)

3,442/15. **Carbon Electrodes.** G. MENDHEIM. A method of baking moulded carbon electrodes in which the tar vapour evolved is employed as fuel for the baking process. (Three figures.)

4,348/15. **Telegraphy.** EASTERN TELEGRAPH CO. and A. C. GARDINER. The combination in a telegraph transmission system of two polarised relays which act as a pole-changer for the signalling battery, one relay being operated by the depression of the Morse signalling key and the other by its release after a signal has been sent. (Four lgures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Dynamos, Motors, and Transformers: J. STONE & CO. and DARKER [Dynamos] 1,435/15; SUNDERLAND FORGE & ENGINEERING CO., SCOTT, and ROBERTSON [Rotors] 2,624/15; BRITISH WESTINGHOUSE ELECTRIC & MFG. CO. [Motor control] 12,340/15; HUNT and SANDYCROFT, LTD. [Synchronous machines] 15,113/15.

Instruments and Meters: LYON [Battery testers] 5,261/15.

Switchgear, Fuses, and Fittings: GRIGSBY [Lamp supports and casings] 1,500/15; I. FRAKENBURG & SONS, LTD., and FLEMING [Electric lighting] 5,768/15; LUNDBERG, LUNDBERG, LUNDBERG, and PEGG [Connectors] 6,898/15; TAFFINDER [Adjustable fittings] 8,099/15.

Telephony and Telegraphy: ZIVNOSTENSKA BANKA [Telephone exchange systems] 20,856/13; COOLEY [Telephone systems] 1,087/15; RELAY AUTOMATIC TELEPHONE CO. [Automatic and semi-automatic telephone systems] 1,471/15; SIGNAL GES. [Submarine telegraphy] 1,857/15; AUTOMATIC TELEPHONE MFG. CO. and SMITH [Telegraph systems] 2,343/15; RAINEY [Multiplex telegraphy] 10,983/15.

Miscellaneous: STILES and PERL [Coin-freed illuminating apparatus] 2,078/15; SUTTON and SUTTON [Batteries] 2,687/15; ROBERTSON and LENNOX [Electrical reversing mechanism for planing machines, &c.] 5,224/15; OLDHAM [Miners' lamps] 5,513/15; SUWA [Bells] 10,334/15; ROCH [X-ray bulb regulators] 13,837/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

(Numbers in italics are those that will finally be borne by the specifications under the new system.)

Ignition: C. T. MASON [Ignition dynamos] 541/16 (*100,031*).
Telephony: BETULANDER [Automatic telephones] 12,671/15.
Miscellaneous: WHEELER [Cathode for electrolytic cells] 15,759/15.

Amendment allowed

7,235/11. **Electrometallurgy.** U. C. TAINTON and J. N. PRING. Leave has been granted to amend this specification by the omission of a claim and by making other verbal alterations. The specification describes a process of electrodeposition of zinc using an electrolyte containing a large proportion of acid, a small proportion of a colloid or gum, and a zinc salt. The claim now omitted covered the use of this electrode in secondary batteries with zinc electrodes as well as for electrolytic purposes.

Opposition to Grant of Patents

Opposition has been entered to a grant of a patent on the following application:—

11,555/15. **Wireless Telegraphy.** K. VREELAND. The production of undamped oscillations by a method involving the use of a mercury vapour arc concentrated in a restricted stream.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

4,754/02. **Motors.** R. LUNDELL. Field magnet systems composed of overlapping laminations threaded on steel rods and held in a solid skeleton frame.

5,104/02. **Arc Lamps.** S. G. and P. DE MESTRE. Enclosed vertical flame arc lamps.

The following are the more important patents that have become void through non-payment of renewal fees.

Arc Lamps: H. BECK [Magnetic blow-out for flame arc lamps] 23,511/04.

Incandescent Lamps: W. P. THOMPSON (*Deutsche Gasgluhlichtges.*) [Mounting of metal filaments] 22,353/05.

Instruments and Meters: R. CHAUVIN and R. ARNOUX [Electromagnetic speed indicators] 23,793/03.

Telephony and Telegraphy: W. FAIRWEATHER (*Brown Hoisting Machine Co.*) [Metal masts for wireless telegraphy] 24,161 and 24,162/06; H. KNUDSEN [Facsimile wireless telegraphy] 23,570/08; W. FAIRWEATHER (*L. M. Ericson & Co.*) [Central battery telephone systems] 25,022/09.

Miscellaneous: P. C. HEWITT [Mercury vapour rectifiers] 4,168/03; F. W. HURD [Coal-cutters] 24,125/06; L. SAVART and J. GRAINDORGE [Electric horns] 5,089/08.

E.H.T. Tests on Cables with Continuous Current.—We very much regret that by an oversight the name of the author, Mr. O. L. Record, was omitted from our article on "E.H.T. Tests on Cable with Continuous Current" on page 57 of our last issue. In offering Mr. Record an apology for this, we would like to draw attention to the fact that his name was duly mentioned in the "Summary" on page 55. At the same time we may mention an error in the tenth line from the bottom of the first column of the article in question, which, however, was reproduced from the original paper; for "1 and 2" read "1 or 2."

British Industries Fair.—The British Industries Fair, which is being held at the Victoria and Albert Museum from Feb. 21st to March 3rd, has not a great deal of interest for the electrical industry, and what there is relates mostly to glassware and small electrical apparatus. Messrs. Ward & Goldstone, Ltd. (Sampson Works, Springfield Lane, Salford, Manchester), have a good show of the latter class of goods, and particularly of battery lamps for various purposes, and in the same category may be mentioned the British Ever Ready Co., Ltd. (Hercules Place, Holloway), which has a similar range of inspection lamps, &c., the source of supply being furnished by batteries. Model electric motors are shown by the Efandem Co. (Fallings Park, Wolverhampton), and a miscellaneous collection of small but useful electrical apparatus is to be seen at the stand of Messrs. F. Darton & Co. (142 St. John Street, Clerkenwell). A number of firms show glassware suitable for electric lamp shades and reflectors. An indication of the effort which has been made by the Board of Trade to give this exhibition world-wide notice is seen in the issue of no fewer than 100,000 invitations, of which 20,000 were sent out to oversea firms some time ago. Wholesale buyers who have not received invitations should apply to the Board of Trade, British Industries Fair, 32 Cheapside, E.C.

"The Central."—The January issue of the Old Centralians' journal, although thinner than usual, contains matter that will interest old students. The notes contain much information with regard to those who are filling military duties, or are otherwise engaged on war work.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,483.

How often should an induction motor be tested for drop in the armature due to wear of bearings? The motor in question is a Century (Chicago, U.S.A.), three-phase, 3-h.p. motor, driving a fan for organ blowing. There are only two bearings to the set, the fan being on a shaft extension outside the bearing. The motor runs on an average eight hours a week.—"Kirk."

(Replies must be received not later than first post, Thursday, March 2nd.)

ANSWERS TO No. 1,481.

In a large cold storage warehouse it is desired to have an indicator, say an ordinary 16-c.p. carbon filament lamp, coloured red, to determine if all lights are switched off before the premises are closed up for the night, this in case of a workman being accidentally locked up in one of the chambers. How could this be best accomplished with minimum risk of failure to the indicator?—E. W.

The first award (10s.) is made to "S. B. S." for the following reply:—

S (Fig. 1) is a double-pole throw-over switch. When in contacts *a* it is acting as the main switch. To test for lamps being switched on, change over to contacts *b*, when, if any

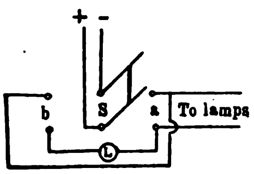


Fig. 1.

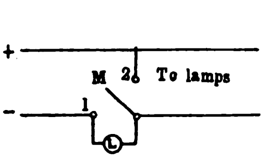


Fig. 2.

lamps are switched on, the lamp L will light. If L does not light, to make sure it is not due to a faulty lamp, switch on one circuit of lamps for a few seconds.

The second award (5s.) is made to "A. N." for the following:—

Two types of indicators may be suggested. Fig. 2 shows the first type. The indicator, consisting of a glow lamp, is connected across a two-way switch. The latter is shown in position M, midway between the two stops. The switch on stop 1 closes the load circuit. Whether all load is off, or some of it is on, can only be determined by switching it off (position M) and observing whether the lamp glows. If the lamp remains dark, there are two alternatives: (1) the load is off, or (2) the lamp is burnt out (failure). To ascertain that second alternative does not take place, the switch is put on contact 2, when the lamp ought to light up.

Note.—If the load is very light (say one lamp only) the indicator lamp will only glow weakly. Care must be therefore taken that the lamp is quite out at position M.

Fig. 3 shows the second type of indicator. This has a more complicated arrangement, but has the advantage of indicating directly whether the load is on. Its main constituent part is a current relay, which opens the indicator lamp circuit whenever the load is on. The relay has to be able to carry the full load current, but must operate with the minimum current flowing (*i.e.*, when only one lamp is alight). To safeguard against any trouble in the relay,

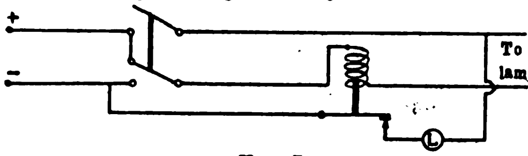


Fig. 3.

causing it to remain insensible to current, the arrangement shown must be adopted. There is a double-pole switch closing the load on the mains and an extra contact putting the indicator lamp in series with the load when the double-pole switch is opened. If the lamp remains glowing in position of switch as shown, there must be some load left on, even if the relay is inactive.

W. H. writes us:—

"Dynamo's" reply to Question 1,480, published in your issue of Feb. 17th, contains several incorrect statements. He states that "by increasing the brush lead the volts are lowered and brought back to the correct value by decreasing the shunt resistance, thus bringing the machine farther from the steep part of the curve, and consequently improving matters."

This is obviously wrong, for when the machine is generating 220 volts at any particular load the flux *must* be the same in the air gap, and therefore the machine is working on the same part of the curve whether the brushes are in the neutral or are given forward lead.

The true reason for the less effect of the anti-compounding turns is as follows:—When the brushes are given a forward lead the ampere turns on the field are increased by reducing the shunt resistance until the extra ampere turns are equal to the armature demagnetising turns produced by the brush lead. The flux is the same when the volts are the same as before, but the ampere turns are greater, therefore any variation in the load current causing a change in the anti-compounding ampere turns on the field has less effect than before. The actual change is the same, but the percentage change is less in the case where forward lead is given.

He also states that "the remedy for the trouble is to connect the series winding right." This will correct one error, but will, of course, have no effect on the high voltage generated on no load.

The only remedy for this is as stated by myself, and that is to supply a larger field resistance or rewind the field.

[The lower voltage referred to by "Dynamo" is not due solely to demagnetising effect, as W. H. assumes, but also to the fact that the brushes are removed from the points of maximum P.D. on the commutator. His reason for the high voltage on no load canot be correct. We agree that more field resistance is necessary.—Ed. *E.E.*]

Electric Wiremen's Work.—Messrs. A. P. Lundberg & Sons write to us concerning the subject of the City and Guilds syllabus, the last report of which states that there were 1,341 candidates for examination in "Electrical Engineering," and 253 in "Electric Wiremen's Work." Messrs. Lundberg argue that "these figures indicate a very topsy-turvy condition of things, and prove that fundamental training in applied electrical work is to a great extent ignored by those whose duty it is to foster it. For every student who is investigating the mysteries of dynamo design, alternating-current work, transmission systems, electrical instrument making, &c., &c., there should surely be a dozen or so who only desire a working acquaintance with every-day electrical matters. It would be absurd, of course, to depreciate the value of the subjects included under 'Electrical Engineering' in the City and Guilds syllabus. But it seems quite evident from the above-quoted figures that we are paying too much attention to what might be termed exclusive subjects, and neglecting another subject which—if properly handled—should be spreading every-day electrical knowledge amongst thousands of people yearly. This would be to the ultimate benefit of the whole electrical profession and industry."

Possibilities of Trade with Russia.—A memorandum prepared by the Acting British Consul-General at Moscow upon the possibilities of British trade with Russia, appears in the Feb. 17th issue of the Board of Trade Journal, and is well worth serious consideration by British electrical manufacturers. This suggests methods of developing British trade, gives a comparison between British and German methods, and points out that the best proof that expenditure upon branch establishments will not be in vain lies in the fact that in almost every case when British firms have gone to the trouble of setting up their own branch or agency it has met with unqualified success. In other words, it is perfectly useless to do business with Russia by correspondence.

ELECTRIC TRACTION NOTES

Among the important electrical construction orders delayed owing to the war was the extension of the electrification of the London, Brighton & South Coast Railway. The suspension of this was not entirely due to the shortage of labour and material; it was partly due to the fact that the subcontract for the electrical equipment of the rolling stock had been given to the Allgemeine Elektricitäts Gesellschaft of Berlin. We learn that considerable difficulties were met in obtaining an assurance from the Government that this contract might be regarded as cancelled, but that the railway company and the main contractors, the Metropolitan Carriage, Wagon & Finance Co., Ltd., finally took the bull by the horns, and decided to order the equipment from the Westinghouse Co. As we pointed out in an article on the question on Oct. 8th, 1914, although the first electrical equipment of the rolling stock of the L.B. & S.C. Rly. was carried out by the German Co., it was done to the fairly detailed specifications of the Consulting Electrical Engineer, Mr. Philip Dawson, and there seemed to be no reason why equally good if not better material could not be obtained from a British or neutral firm, especially in view of the experience which had been obtained with the original plant, and the possible improvements which must necessarily have suggested themselves. The high-tension cable is an interesting part of the scheme, as the transmission pressure to the substations will be 60,000 volts single-phase. Pairs of single-conductor cables will be employed, and as the middle point of the transformer secondaries will be earthed, the actual potential of each main will be 30,000 volts. The cable was ordered from the Electrical Engineering & Equipment Co., Ltd., and is being made at the Berthoud-Borel works in Switzerland and France.

The construction and operating details of the electrified Philadelphia-Paoli branch of the Pennsylvania Railroad formed the subject of a Paper read by Mr. George Gibbs before the American Society of Civil Engineers on Jan. 3rd. We have already described the repulsion-starting motors for this railway (ELECTRICAL ENGINEERING, Dec. 23rd, p. 507). Owing to its having an important and successful third-rail direct-current installation at its New York terminal, the railway company was naturally predisposed to adopt the same system in Philadelphia, but after investigation it was concluded that a high-tension overhead contact wire was more suitable for long-distance traction with heavy and relatively infrequent train units, and presented also the fewest objectionable features for the equipment of large and complicated yards. The mercury-arc rectifier would make it possible to operate direct-current or alternating-current motors interchangeably on either an alternating-current line or a direct-current line, and the company was thus enabled to adopt the alternating-current system in Philadelphia with the assurance that if Philadelphia and New York were electrically connected in the future, the two systems could work together.

According to the *Elektrotechnische Rundschau*, electromagnetic couplings are being introduced on the German railways for shunting purposes. The buffers on the shunting locomotives are replaced by iron cylinders wound as electromagnets and the front buffers of the trucks fit into a semicircular recess in these cylinders. To release the truck, it is only necessary to switch off. A considerable saving in labour for shunting operations is anticipated.

The Siemens-Schuckertwerke have introduced a controller handle and reversing switch handle made of iron and wood with which to replace the copper and brass handles now in use on tramcars, so that the latter may be "mobilised," with all other available copper, for the needs of the German army.

The accounts of the London and South-Western Railway for last year show that a sum of £327,600 was spent upon electrification of its suburban track, and £180,600 on power-house equipment.

The dividend announcements for 1915 of the Metropolitan District Railway Co. and its associated group of tube railways have been made. The Metropolitan District Railway Co. pays 3 per cent. on the second preference stock, compared with 2 per cent. for 1914; the London Electric Railway Co. pays ¾ per cent. on the ordinary shares, compared with ⅝ per cent.; the Central London Railway Co. pays 2 per cent. on the deferred ordinary stock, 3 per cent. on the ordinary stock, and 4 per cent. on the preferred ordinary stock, compared with 1¼, 2⅝, and 4 per cent.; and the City & South London Railway Co. pays 5 per cent. on all its preference stocks, compared with 5 per cent. on the 1891 and 1896 stocks and 2½ per cent. on the 1901 and 1903 stocks in 1914.

LONDON SUPPLY COMPANIES' DIVIDENDS

SINCE our note last week pointing out that the St. James' & Pall Mall Electric Light Co., the Westminster Electric Supply Corporation, and the Chelsea Electricity Supply Co. were paying smaller dividends for 1915 than in 1914, the accounts and dividend announcements of other electric supply companies go to show that a reduction in dividend is fairly general. The position of the St. James' & Pall Mall Co. was further elucidated at the annual meeting on Feb. 15th, when it was pointed out that the main reason why the dividend for 1915 is down by 2 per cent. is increased expenditure, which has shown itself chiefly in the accounts of the Central Electric Supply Co., upon which the St. James' Co. relies very considerably for their supply. The costs of the Central Co. having risen materially, it was thought desirable that no dividend should be declared by that company, whereas in 1914 a dividend of 5 per cent. was declared. At the same time there has been a large capital expenditure in respect of a new turbo-alternator at the Grove Road Works of the Central Co., together with additional boiler plant, coal storage capacity, &c.

Of the new announcements since last week, the London Electric Supply Corporation declares 3 per cent. on its ordinary shares, as compared with 4 per cent. in 1914, and only £5,000 is transferred to contingencies account compared with £17,000 a year ago. It is interesting to note that there has been an increase of nearly 4½ million units in sales, but that the price of coal and wages have resulted in the cost per unit rising from 0·50d. to 0·64d., and the expenses of generation generally have increased by nearly 50 per cent. The Kensington & Knightsbridge Electric Lighting Co. has also announced a reduced dividend, the figure being 7 per cent. as against 9 per cent.; and the Chelsea Electricity Supply Co. recommends 4 per cent. on the ordinary shares against 5 per cent. in 1914.

On the other hand, the Notting Hill Electric Lighting Co. declares 5s. per share, as in 1914, on the ordinary shares, although there was a reduction of £1,604 in the profit, due mainly to the higher rate of income tax. Once again, too, the company's employees will have an addition of nearly 8 per cent. to their wages distributed under the co-partnership scheme.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"Principles of Direct-Current Machines." By A. S. Langsdorf. 404 pp. 8¼ in. by 5¾ in. 313 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 12s. 6d. net.

"Wireless Telegraphy." By J. Zenneck. Translated from the German by A. E. Seelig. 443 pp. 9¼ in. by 6¼ in. 468 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 17s. net.

"The Electric Railway." By A. M. Buck. 390 pp. 9¼ in. by 6¼ in. 193 figures. (New York: McGraw-Hill Book Co.; London:, Hill Publishing Co., Ltd.) 12s. 6d. net.

"British Standard Specification for Wall Plugs and Sockets" (Five Ampere Two-pin, without Earthing Connection). Engineering Standards Committee Report No. 73. 12 pp. 13¼ in. by 8¼ in. 1 plate. (London: Crosby, Lockwood & Son.) 5s. net; abroad, 5s. 2d.

"British Standard Specification for Charging Plug and Socket for Vehicles Propelled by Electric Secondary Batteries." Engineering Standards Committee Report No. 74. 15 pp. 13¼ in. by 8¼ in. 3 plates. (London: Crosby, Lockwood & Son.) 5s. net; abroad, 5s. 2d.

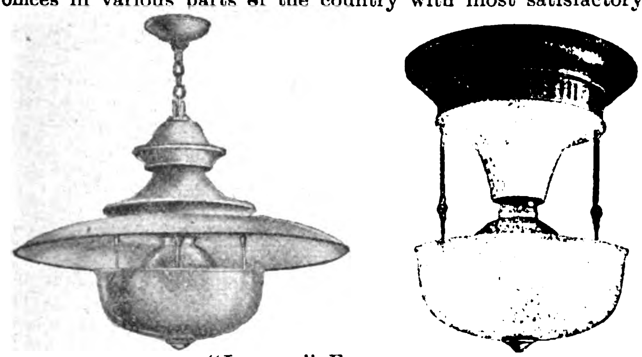
"Aeroplanes and Airships." By W. E. Dommett. 106 pp. 7¼ in. by 4¾ in. 38 figures. (London: Whittaker & Co.) 1s. net; by post, 1s. 2d.

"*Mechanical World* Electrical Pocket Book for 1916." 240 pp. 6¼ in. by 4¼ in. 130 figures. (Manchester: Emmott & Co., Ltd.) 6d. net; by post, 8d.

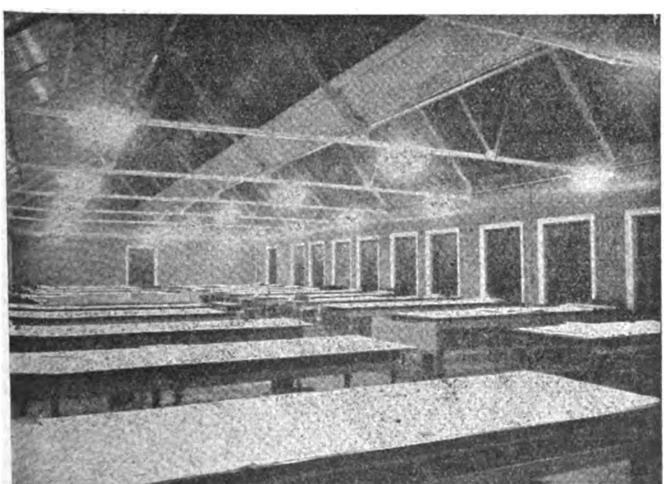
"Lektrik Lighting Connections." With Introductory and Explanatory Notes. By W. P. Maycock. 146 pp. 4¾ in. by 3 in. 180 figures. (London: A. P. Lundberg & Sons.) Fourth edition. 6d. net; by post, 7d.

THE LIGHTING OF DRAWING OFFICES

THE use of Mazda half-watt lamps in "Lumina" semi-direct lighting fittings has been adopted for drawing offices in various parts of the country with most satisfactory



"LUMINA" FITTINGS.

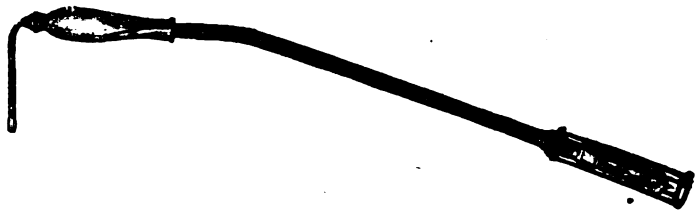


"LUMINA" SEMI-INDIRECT LIGHTING INSTALLATION.

results, not only from the general illumination point of view, but from the practical aspect of the draughtsman. One of our illustrations shows the interior of the drawing office of a certain engineering and shipping firm in the Newcastle area, whose reputation is world-wide. So effective has been the lighting of this drawing office on the Mazda semi-indirect system that the engineer of this company has stated he experiences difficulty in preventing the draughtsmen using the artificial light during the daytime, the effect being, it is declared, better than natural daylight. Our other illustrations show the close ceiling and pendant patterns of "Lumina" fittings.

A SHELL INSPECTION LAMP

WE illustrate another type of shell inspection lamp, made this time by the Edison & Swan United Electric Light Co., Ltd. (Ponder's End, Middlesex). This is provided with an earthing device, and is sent out wired complete with lampholder (S.P.C.) and three yards of 3-way (2-way and



SHELL INSPECTION LAMP.

earthing wire) circular workshop quality flexible cord. The chief point of this fitting is its construction, which is specially strong with a view to the hard use to which it will undoubtedly be put to in the factory, whilst another very essential point is the fact that the lamp is listed at 12s. 6d. only.

"ARORA" FIRES

A SHORT time ago we announced that Mr. F. S. Grogan, after a long association with the British Electric Transformer Co., Ltd., during which he established a considerable reputation in connection with the development of electric cooking and heating apparatus, had severed his connection with that firm to start business on his own account.

The Arora Co., of Loughborough, has now started operations. Mr. F. S. Grogan is manager, and is associated with Mr. Eric W. D. Burder, a member of the Loughborough Electric Supply Committee, who has an engineering works and foundry at his disposal. These works extend over many acres on the outskirts of Loughborough, and, besides having their own private railway siding, goods can be despatched on two other main railways.

The element employed in the "Arora" fires is built of an extra heavy section of wire, which under ordinary circumstances would not glow, but owing to the patented form of construction a most pleasing glow is obtained at quite low current density and a maximum of radiant heat produced. These elements are mounted on fireclay, the framework being of cast-iron in two main parts, namely, the fire-box and the front. The former is a complete unit forming a standard part, which is interchangeable with any front of the three finishes listed. It contains two 750-watt bars, two switches, and two heavy terminals, complete with two yards of 70/36 S.W.G. flexible cord, and is attached to the front frames by means of two bolts only. These bars are also interchangeable, and may be obtained at the low cost of 3s. 3d. net per 750-watt bar. The first three types of these fires were put upon the market in the middle of January this year, and within a month orders were received from some forty municipalities, and many repeat orders for large numbers have since come in. Three additional types are now going through the works, being three inches higher to allow the addition of a third fire bar, and we understand that very shortly a boiling-plate of the open type will be put on the market to meet the demands of the public and many central station engineers for a quick and reliable boiler at low price.

Electric Welding.—A useful paper descriptive of modern methods and applications of electric welding was read by Mr. H. W. Wolton before the Birmingham and District Electric Club, on Feb. 12th. A brief description of various welding processes is given, including the arc and electric resistance methods, the treatment of the latter covering spot, seam, and butt welding. A table of comparative costs for various classes of work is appended, showing that in most cases electric welding is 50 per cent. cheaper than forge welding or brazing.

LOCAL NOTES

Brighton: *Electricity Charges.*—The scheme for reorganising the electricity charges, referred to on page 36 of our issue for Jan. 27th, was passed by the Council last week. It provides for the abolition of the various scales of charges now in use, including the maximum demand system, and the substitution of a flat rate for lighting, varying from 4d. to 5½d. per unit, according to consumption, the lower rate applying to consumers using 4,000 units per annum and upwards.

Huddersfield: *Cost of Coal.*—Referring to the accounts of the electricity department for last year, Alderman Marsland stated last week that whereas the quantity of coal used had increased by 36 per cent., the cost had risen by no less than 75 per cent. The average cost per ton in 1914 was 10s. 10d., in 1915 13s. 11d., and, so far, in 1916, it had been 15s. So serious was the effect of this that it was anticipated a further increase in the price of electricity would have to be made.

Hull: *Electricity Works Smoke Nuisance.*—The Acting Borough Electrical Engineer has reported with regard to complaints of the emission of smoke at the Sculcoates Lane generating station. The Health Committee has called for the replacement of all existing furnaces by so-called smoke-consuming furnaces, and it is pointed out that to replace the existing mechanical stokers, which are regarded as the best type available, would entail a very costly experiment. It is pointed out that from time to time various patents have been placed on the market for the entire elimination of smoke, but they do not in practice fulfil the claims made for them. Although the staff had constantly before them the importance of eliminating smoke, there had been little opportunity of achieving the best results owing to the abnormal conditions prevailing during the past eighteen months. It was further pointed out that even if the Health Committee's suggestions were carried out the plant could not be obtained before the undertaking would be working under normal conditions, when no complaints had been made.

Liverpool: *Women Electricians.*—The scheme for training women as electricians, referred to on page 492 of our issue of Dec. 9th, 1915, does not meet with the approval of the Liverpool branch of the Electrical Trades Union, which has passed a resolution recording the opinion that the time has not yet arrived for such a departure. A scheme has been submitted to the Ministry of Munitions by which women electricians are to receive the same wages as men now employed on electrical work when they have passed an examination by a competent authority. During the period of training the rate of pay will be 15s. per week.

Vacancies on Electrical Staff.—The Tramways & Lighting Committee have decided that vacancies in the electrical department shall, as far as possible, subject, of course, to suitable qualifications, be filled by soldiers and sailors discharged through disablement.

APPOINTMENTS AND PERSONAL NOTES

Lance-Corporal H. A. Voss, London Electrical Engineers (T.F.), has been promoted to 2nd Lieutenant on probation.

Second-Lieutenant M. G. Bland, A.M.I.E.E., London Electrical Engineers (T.F.), has been promoted to Temporary Captain.

The Blackburn Electricity Committee have decided to increase the salary of Mr. P. P. Wheelwright, the Borough Electrical Engineer, by £100 per annum.

The death has occurred, in his sixty-fifth year, of Mr. John Wood, senior partner of the firm of Mosses & Mitchell, of Chiswell Works, Golden Lane, E.C.

We regret to hear that Mr. A. L. Sabine, late Secretary to Siemens Brothers & Co., Ltd., died last Sunday, the 20th inst. He was Secretary from 1880 to 1910, retiring in the latter year after fifty years' service.

Mr. T. K. Robertson, Staff Superintendent in the Marylebone Electric Supply Department, has been granted a further three months' leave of absence on account of ill-health.

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £135 to £137. (Last week £135 to £138.)

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The Grafton and South Grafton Municipalities (N.S.W.) have in hand a water-power electric supply scheme at an estimated cost of £23,000.

Barnes.—The maintenance of the storage battery is under consideration, the contract with the Tudor Accumulator Co. having now expired.

Belfast.—The Tramways & Electricity Department require six or twelve months' supply of cables, accessories, lamps, carbons, meters, time switches, service cutouts, &c., &c. Town Clerk. March 15th. (See an advertisement on another page.)

Kilmarnock.—A new 11,000-volt cable is to be laid to supply the Allandale Pit of the Caprington and Auchlochan Colliery.

Pontypridd.—Twelve months' supply of installation stores and sundries, joint-boxes and service cutouts, tramcar equipment, tramways overhead equipment, glass and globes, cables and wires, insulating material, meters, &c. Borough Electrical Engineer. March 13th.

Miscellaneous

Brazil.—In his annual report the Acting British Consul-General at Rio de Janeiro calls attention to the opening there for electrical insulators hitherto supplied almost entirely by Germany. Samples of German insulators can be seen and other information obtained at 73 Basinghall Street, E.C. Reference number (47) should be quoted.

Dover.—The Dover Harbour Board require six or twelve months' supply of cable and electrical sundries. Secretary, Castle Street. March 9th.

Edmonton.—The Union requires six months' supply of electric lamps. Clerk. March 8th.

Ireland.—The Great Northern Railway Co. of Ireland require electric battery materials for carriage lighting. Secretary, Amiens Street Terminus. March 1st.

London.—Great Central Railway Co. require six or twelve months' supply of arc lamp carbons, electric light casing, accessories, and lamps. Secretary, Marylebone Station. March 7th.

Newport (Mon.).—The Guardians require a supply of electric light fittings. Clerk, Queen's Hall. Feb. 29th.

West Ham.—The Guardians require a three months' supply of electrical fittings. Clerk, Union Road, Leytonstone. March 2nd.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Dover.—The tender of McIntosh's Cable Co. has been accepted for cable at £3,395.

London: *Hampstead.*—In connection with the breakdown of the Westinghouse 1,000-kw. turbo-alternator on Jan. 15th, some damage was done to the main switchboard. This part of the board being of an obsolete pattern, the Electricity Committee has placed an order with the British Thomson-Houston Co. for a modern switchboard at £3,886.

London: *L.C.C.*—Twelve months' supply of insulating materials:—R. W. Blackwell & Co., British Insulated & Helsby Cables, Ltd., Siemens Brothers, Ltd., Micanite & Insulators Co. For electric lamps, the tenders of Corona Lamp Works, Ltd. (£1,150), Cryselco, Ltd. (£2,500), and Edison & Swan United Electric Light Co. (£170), have been accepted. In each case the contract is for twelve months, the last-named for carbon filament lamps and the others for metal filament lamps.

Midland Railway Co.—The tender of the General Electric Co., Ltd., for the supply of Osram drawn-wire lamps for the ensuing twelve months has been accepted.

Preston.—Messrs. Chamberlain & Hookham, Ltd., have received a contract from the Corporation for the supply of meters for the coming year.

Shanghai.—The General Electric Co., of Shanghai, have for the sixth time been successful in securing the yearly contract for the supply of "Osram" traction lamps to the Shanghai Tramways.

ELECTRICAL ENGINEERING

With which is Incorporated

THE ELECTRICAL ENGINEER

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SUMMARY

We publish a specially contributed article on the progress made by the electric furnace in Sheffield since the outbreak of the war, and the practical advantages of the electrical over the older processes (p. 72).

A discussion at the Mining Institute of Scotland of Mr. S. Mavor's paper on "Compressed Air for Coal Cutters" brought out the serious possibilities of wastage in collieries where compressed air was exclusively used (p. 73).

A number of practical details in regard to electric coal cutting, winding, and haulage were given in a recent paper before the Nottingham Society of Engineers (p. 73).

Among the subjects of specifications published last Thursday at the Patent Office were telephone systems, dynamos, low voltage lighting, and motor control. A magnetic separator patent has been granted in spite of opposition. Patents for motors and liquid starters expire this week after a full life of fourteen years (p. 75).

An accumulator locomotive which has been giving excellent results on the Midland Railway is described. Satisfactory success is attending the London suburban railway electrification schemes (p. 76).

The Western Electric Co.'s semi-automatic telephone system is described. There is a feeling on the part of some members of the Post Office staff that a trial on a large scale should be made (p. 76).

Our "Questions and Answers" page this week deals with rules for calculating windings for electromagnets for various purposes (p. 77).

In a paper read before the Liverpool Engineering Society last week, Lieut. Haydn Harrison explained the reason for the increased efficiency of searchlights using lamps on the Beck principle; he also advocated the use of highly concentrating reflectors with diffusing globes for domestic lighting, and contended that lamps with similar reflectors on high posts, far apart, for street lighting would be as efficient as the present methods using flame arc, and would only require about one-fifth the electric power (p. 78).

All arc lamps for street lighting in the City of New York are to be replaced with large "half-watt" lamps during the present year (p. 79).

The profits available for rate relief from the Birmingham Electric Supply Department for 1915–16 are £10,000 less than in the previous year.—Charges are to be increased at Sunderland (p. 80).

Two 1,000-kw. and one 500-kw. rotary converters are required at Salford; generating plant at Bolton; and stores in various towns (p. 80).

Regular readers of "Electrical Engineering" should now ORDER their copies from their newsagents or at the bookstalls at which they customarily buy their weekly copies.

The Government has decided that strict economy in paper is necessary, and, in consequence, to prevent waste, the majority of newsagents and bookstalls will limit their stocks so far as possible to the actual known requirements of their customers. A mere verbal order will, however, be sufficient to ensure that a copy is sent or reserved weekly.

"Electrical Engineering" can also be sent direct to readers by post. Copies are posted on Wednesday evening, and should reach readers in practically every part of the United Kingdom on Thursday (in London, and many other towns, by first post). Orders, with a remittance of 6s. 6d. for one year, 3s. 3d. for six months, or 1s. 8d. for three months, which includes postage (Colonies and Abroad 8s. 8d. per annum), should be sent to the Kilowatt Publishing Co., Ltd., 203, Temple Chambers, London, E.C.

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D
Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Thurs., Mar. 2nd: Shooting for Sections III. and IV.

Fri., Mar. 3rd: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Mar. 4th: Adjutant's instructions class at 2.30 p.m.

Mon., Mar. 6th: Sections I. and II., technical. Sections III and IV., lashings and trestle bridging. Signalling class and recruits.

Tues., Mar. 7th: School of Arms, 6.0 to 7.0 p.m.

Thurs., Mar. 9th: Shooting for Sections I. and II., and signalling class.

Fri., Mar. 10th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Mar. 11th: Uniform parade, 2.45 p.m. Members will parade with the 4th Batt. Central London Regt., and will proceed by train to Woldingham, where they will be given an opportunity of inspecting the trench digging now being carried on there.

Members wishing to stay in camp on March 11th at Woldingham must give in their names at once.

Sections for technical parade at Headquarters, London Electrical Engineers, 46 Regent Street, S.W.

Sections for shooting parade at miniature ranges.

(For "Arrangements for the Week" see p. 80.)

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

THE WAR AND THE ELECTRIC FURNACE IN SHEFFIELD

(*Specially Contributed.*)

THE progress which the electric furnace is making in the Sheffield steel trade at the present time is generally recognised; in many quarters this progress is attributed solely to the conditions brought about by the war.

Though it is true that the war has been the means of bringing the good qualities of the electric furnace well to the front, yet it is stating only half the truth to assert that the war alone is responsible for the success of this method of steel manufacture, for such an opinion gives rise to the idea that it is not owing to any intrinsic merits of the electrical process, but simply to some matter of great convenience, which at the present time counts for so much.

Such an opinion is quite incorrect, and the outstanding fact about the matter is that electrically-produced steel has made its way into the market, and will hold its place there, simply and solely for the reason that it is possible to produce steel of greater excellence by electrical means than by any other process.

Along with the superlative quality of the product goes the very important advantage that results once obtained can be repeated at will time after time; in fact, the control of the steel produced is rendered practically absolute with electrical means.

Steel manufacture depends for its success on the complete removal of all impurities from the raw material fed into the furnace, and the adding to the product of such proportions of carbon, manganese, chromium or nickel, or other suitable alloy as shall produce a steel of the quality desired for any particular purpose.

The most important matter in the whole process is the removal by oxidisation of the impurities contained in the scrap fed into the furnace. This process is dependent on the nature of the slag used in the furnace, and consequently the slag which is thrown in after the furnace has got well started up may be described as the deciding factor in the production of good steel. It thus comes about that a town situated in a good position for obtaining the most desirable materials for slag and fluxes is in a better position for steel-making than a town situated on a good ironfield but lacking in a plentiful supply of the necessary slag materials close at hand.

The success of the electric furnace is due to the fact that the electrical process permits the refining and purifying action of the slag to operate to a much higher degree than is possible in the older type of furnace. It may then be asked: Why has not this valuable property been discovered previously? The answer is that electrical steel-making, like all other new processes, has had to pass through the usual stages of trial and failure; of too enthusiastic promises in the early days by electrical men who were certainly not steel-makers, and has had to face the competition of the older methods, in which a very high degree of skill and judgment is hereditary in the workmen carrying out the process. Owing to this great skill on the part of the steel-melters, it has long been possible to produce steel of remarkably high quality for any required purpose. It is in rendering the difference between excellence and super-excellence possible, not only as a casual and fortunate event, but as a regular process repeatable at will, that electricity has taken the manufacture of high-class steel one stage further.

It is now some eight or nine years since the introduction of the first commercially-worked electrical furnace in Sheffield. This was of the single-phase type, and suffered from the disadvantages due to working through a motor-generator; still, though progress was slow, a second furnace was installed, so that even in those days there must have been some outstanding advantage in some process to the credit of the electrical method. With the advent of the two- and three-phase furnace the efficiency was increased, and further extension became possible. Then came the demand for superlative qualities of steel, and this demand has been so well met by the electrical method that to-day it holds an assured position in the industry.

Three types of furnace are in use, and it is satisfactory to learn that all three types give excellent results. The Héroult type of furnace is much in evidence, the company having at their disposal a large amount of actual practical experience. The type of furnace manufactured by Electro-Metals, Ltd., has also found favour, whilst there is one example of the Rennerfelt furnace in regular operation. All three furnaces are of the arc type, but as they all differ in the manner of applying the arc to the furnaces, a few brief notes on their respective methods will be given.

The Héroult furnace, now of the three-phase type, consists of three electrodes each carrying one phase; the current passes through the electrodes, to the surface of the metal in the furnace, and along that surface; this type is giving very satisfactory results, and works at a high efficiency, especially with cold charges.

The second type, that introduced by Electro-Metals, Ltd., has the electrodes arranged in a different manner. A two-phase connection, of the three-wire type, having a common return, is used in this design, and from a three-phase supply the Scott transformer connection is used. The "A" and "B" phases are attached to vertical electrodes, which are lowered into contact with the charge in the furnace. The common return lead is connected to the bottom point of the furnace beneath the basic lining. This bottom electrode consists of a layer of a mixture composed of tar, dolomite, or magnesite; this lining is burnt in, and when hot is a good conductor. The object of the design is to obtain the benefits of a bottom heat on to the charge, and it is also claimed that a certain amount of circulation is obtained which helps to mix the charge and circulate the heat right throughout the furnace.

The Rennerfelt furnace strikes the arc above the charge, and then deflects the same on to the surface of the metal; this furnace is worked by two-phase current, and three electrodes.

All three types work with low-pressure current, control being obtained by varying the arc between the electrodes: whilst for the different purposes of the initial heating and the refining stages control is available by alteration of the voltage at the transformers.

Control of the arcs is both hand-regulated and automatic, the hand-regulation being by tramway-type controllers, which operate the motors carrying out the work of raising or lowering the electrodes. Automatic control is obtained by means of the Thury apparatus, especially designed for the purpose. The whole of the control apparatus is mounted on the wall in a position convenient to the furnace, and both methods of control are stated to give good working results with little attention. The voltages used vary with the different furnaces to a slight extent; one furnace will be controlled by two voltages of 85 and 75 respectively, whilst another has three selections, namely, 65, 75, and 85 volts. These selections are made on the primary side of the transformer.

Different firms use different methods of procedure in accordance with their requirements. The following description, however, will give a general idea of the process followed, and will allow the benefits of the electrical method to be indicated.

The furnace having been charged, current is switched on and the electrodes adjusted until the arc is struck; the necessary adjustment is then made to get the current required, and the automatic control is put into action. The heat of the arc soon brings the whole charge to the melt, and the first slag is then added to the charge; this may consist of lime, fluorspar, sand, and either a small amount of iron ore or hammer scale. The slag, having a lower specific gravity than the charge, keeps to the top of the metal; the carbon in the charge in the furnace is taken up by the iron ore or hammer scale in the slag, and converted to carbon monoxide; this rises to the top of the charge, agitating the metal and slag, and so bringing the slag and charge into very close contact, and assisting the refining process.

The silicon and manganese in the metal composing the charge are first oxidised and then taken up by the slag; any phosphorus present in the charge is also oxidised, whilst the lime in the slag allows a phosphate of lime to form, which in its turn is absorbed by the slag.

The bugbear of the whole process, however, is the sulphur present in the metal charge in the furnace. Sulphur has a most deleterious effect on the quality of the steel, and is most difficult to remove thoroughly. Part of the sulphur is oxidised

and passed away in gaseous form, but a good proportion of it remains. As most of the impurities in the metal have been absorbed into the slag at this stage, the furnace is tilted, and most of the slag runs off through a slagging spout. To get the phosphorus away, the portion of the slag still on the surface of the charge is dragged off by hand-manipulated tools.

Any carbon to give the required nature to the steel, or any special alloy, is now added, and a special refining slag then introduced to the furnace. The object of this second slag is to get away the remaining proportion of the sulphur, and to remove the oxide of iron which has entered the charge consequent on the melting and on the use of the first slag which removed the phosphorus.

This second slag consists of lime, sand, and fluorspar; it is at this point that the voltage across the electrodes is reduced. The oxide of iron remaining in the charge is got away by being absorbed in the new slag; this slag becomes saturated with the oxide, and, to render it fit to carry out the deoxidisation of the charge completely, finely powdered anthracite is thrown into the slag. This generates carbon monoxide inside the furnace, frees the slag from the excess of iron oxide, and enables it to take up further amounts from the charge in the furnace; this process continues till the deoxidisation of the metal charge in the furnace is complete. Whilst this has been going on, the sulphur has also been taken up by the slag, so that at the end of the process the steel is of a pure and first-rate quality.

It is at this point that the electric furnace gains a great and important advantage. Under the usual process of steel-melting it is possible to get nearly all the sulphur out of the steel, but not all; the electric furnace has succeeded in removing every trace of this obnoxious element, and thereby has raised the quality of steel.

What the exact action in this connection may be is difficult to determine. On fairly sound grounds it is attributed to the presence of calcium carbide in the slag at the time during which the second refining process is being carried through. There is one important feature about the matter, however, and that is that though calcium carbide has been purposely added to the slag, it has not given the results obtained by the electrical process, which allows the calcium carbide to be generated in the furnace itself. It is thought that the action of the calcium carbide when nascent is responsible for the complete removal of the sulphur from the final product. Thus it will be realised that the production of steel is a highly involved chemical process, and it seems fair to assume that the superior heat-control allowed by the electrical method of melting permits this chemical process to be carried out with greater and more certain exactness.

One point about the electric furnace is that by its use it is possible to remelt turnings, borings, and scrap of expensive alloy steels without losing nearly all the alloy. In the usual type of furnace this is not possible without nearly the whole of the alloys being destroyed. The electrical process remelts this scrap with but little loss in this particular, and so enables large quantities of valuable scrap and turnings to be used again. In addition to the use of this fine quality scrap, it is now possible to make bullet-proof steel, as well as steel of a quality so superior that even on these grounds the use of the electric furnaces is thoroughly warranted.

The trend of events at present seems to indicate a very important future for the electric steel furnace; it is fortunate that in Sheffield this is well catered for by the energetic and up-to-date policy pursued by the Corporation Electricity Department.

Miners' Safety Lamps.—In connection with two accidents to miners' lamps in December, the Home Secretary has issued a statement to makers of electric safety lamps. Both lamps were approved types, and the accidents were due to ignition of celluloid. While the lamps were in use underground, a quantity of dense smoke was evolved inside the lamp, and in one case such pressure was developed as to burst the lamp open. In the other case the lamp did not burst, as it was not tightly screwed up, and the pressure was relieved by the gas escaping. On subsequent examination and experiment it appeared that the accidents were due to the loose spring terminals with which the lamps were fitted having been accidentally bent over, and coming into contact, with the result that the accumulator was short-circuited, and the heat thus generated was sufficient to decompose the celluloid of the accumulator case. In order to prevent the occurrence of accidents of this kind in future, the Home Secretary has decided to prohibit the use in approved miners' electric safety lamps of spring terminals liable to be bent over, and a general provision to this effect will be included in the next Safety Lamp Order to be made shortly. Any electric lamps at present in use which are fitted with such terminals should accordingly be refitted at once with rigid terminals—this has already been done by the maker of the type of lamp with which the accidents occurred.

COMPRESSED AIR v. ELECTRICITY FOR COAL CUTTING

THE issue just published of the *Transactions* of the Mining Institute of Scotland contains a report of a discussion of Mr. Sam Mavor's Paper on "Compressed Air for Coal Cutters" (see ELECTRICAL ENGINEERING, Nov. 4th, p. 446). Mr. Black said that a case had recently come under his observation which illustrated the very point that Mr. Mavor wanted to make. He (Mr. Black) had installed temporarily a compressed-air driven duplex double-acting pump of the Worthington type to discharge about 50 gallons of water per minute against a head of 200 ft. The compressor was driven by means of a motor, so that it was quite an easy matter to arrive at the amount of power that was being consumed. He was rather astounded, therefore, on making investigations to discover that this small pump was costing £200 per annum in excess of what an electrically-driven pump of similar capacity would have cost. There was no room for argument on the incident to which he had referred, because the facts were incontrovertible. When one considered a loss of £200 per annum on so small a machine as the one to which he had just referred, one must be alive to the serious possibilities of wastage in collieries where compressed air was exclusively used. An electrically-driven pump would cost about £50 per annum, while the pump mentioned, driven by compressed air, cost £250. He was quite well aware that that particular type of compressed-air pump was not the best that could have been used, but the incident served to emphasise and illustrate what Mr. Mavor wanted to impress upon them in his Paper.

Mr. J. T. Forgie (Bothwell) said that, as an electrical engineer, Mr. Mavor had exercised much self-denial by indicating in the course of his Paper that he could not in all cases recommend electricity in preference to compressed air. One point in Mr. Mavor's Paper that was brought out fairly clearly was that electricity up to a certain stage should be used, and if power was required in some parts of the mine where electricity was undesirable, it would be a simple matter to instal an electrically-driven compressor plant in a suitable position. He was bound to admit that compressed air was the most satisfactory power for rock-drills. Moreover, it was certain that the use of compressed air would be continued in mines because of its convenience and greater applicability to some needs. The first cost of air-compressing plant was greater than that of electric power plant; but, as against that again, the cost of maintaining a compressor plant was very small compared with that for electrical power. The main consideration was the relative costs of each per ton of coal. Approaching the question from that standpoint, he thought that the advantage per ton of coal lay with electricity.

Mr. Dixon, in the course of his remarks, said that he was old enough to remember that the application of electricity to mining had gone through the following three distinct stages:—(1) The stage where users knew nothing about electricity, and put their work into the hands of those who did. (2) The stage where users of electricity found everything so apparently simple that there was nothing in it, and they knew all about it. (3) The present stage, where users realised that, however much they knew, there was a great deal they did not know, and they were content, in the main, to consult with those whose business it was to know. He said he took it for granted that no one would use a compressed-air system if they could have electricity.

ELECTRIC CUTTING, WINDING AND HAULAGE

THE Nottingham Society of Engineers held a joint meeting with the Nottinghamshire & Derbyshire Branch of the Association of Mining Electrical Engineers, on January 19th, to hear a Paper by Mr. R. A. Sheldon, lecturer on electrical engineering at the Nottingham University College, who prefaced his remarks by stating that in a pit completely worked by electricity, the coal might be cut by electrical coal-cutters, conveyed to the gate ends by electrical conveyors, taken by electrical haulage to the pit bottom, and drawn up the shaft by electrical winders. In considering the suitability of the use of electricity underground, they must take into consideration the special conditions which generally obtained there. These were the possible presence of gas, and the consequent risk of explosion, the extreme danger incidental to a fire occurring underground, the presence of dust and damp, the special danger to life from shocks, and the very confined spaces and headroom sometimes available for working. The author first summarised the rules and essential points of practical importance with regard to continuous earthing. With few exceptions, all cables have to be armoured, and

the armour has to have a section 50 per cent. of the conductivity of the conductors. The greatest care must be taken to preserve ample metallic continuity over joint boxes, and to extend this continuity right up to the ultimate confines of the system—past the gate-end box, along the trailing cable, and to the coal-cutter motor frame itself. He reminded his audience that of 86 deaths occurring below ground due to electricity in the nine years ending December, 1913, 40 were due to contact with the outer coverings of apparatus through absence of an efficient earth connection, 12 were due to contact with uninsulated live parts, 32 to defective cable insulation, and two to misadventure and other causes. Thus defective earthing and accidental contact accounted for 60 per cent. of the fatalities. Since the new code of 1911, earthing being more general, the figures were much more conclusive. In the years 1910–14, 10 fatal accidents had occurred in the Scottish group; only two were on armoured systems, and in both cases the armouring was defective. At least four of the 10 accidents would not have occurred in a properly armoured and earthed system. To be fully protected against shocks, all apparatus should be constructed so that no live part was accessible. All switches, &c., should be enclosed in earthed metal cases, so arranged that the lid could not be opened unless the switch was in the off position; and when open, the switch ought to be locked off. Every precaution should be taken to make pump rooms, engine houses, switchboards, &c., as fireproof as possible, and it must not be forgotten that fires might be started by other agencies than electricity. In the Hem Heath disaster last February, which involved the loss of 11 lives, the fire was due to oil lamps, kept to prevent the freezing of exhaust pipes from the compressed air engine. The new rules provided for non-inflammable materials in the construction of switchboards.

It was not useful, necessary, or advisable, Mr. Sheldon continued, to make all underground motors fireproof. A safety lamp to indicate gas was required to be kept near each motor where inflammable gas was likely to be present, and the motor must be switched off if $1\frac{1}{4}$ per cent. of gas was present. As this is well below the danger point, even when dust is present, the provision of explosion-proof motors was not demanded by the Regulations; but motors must be so constructed as to prevent open sparking. Where, however, gas was likely to be found, an explosion-proof motor was, of course, an additional precaution; if some of the explosive mixture gained admittance to the interior of the motor, it might be fired there, and this local explosion be communicated to the air around the motor. To avoid this danger, the original practice, now superseded, was to try and exclude the entry of gas to the interior of the motor by joints made with rubber gaskets and stuffing boxes. This was quite useless, as the motor "breathed" and sucked in air despite every care. Moreover, if an explosion did take place inside the motor, the more the motor was gas-tight, the higher the resulting pressure, and the motor might be wrecked by this internal pressure, the flame spurting out and firing the surrounding gas. According to modern practice, therefore, the motor was merely made strong enough to stand any internal explosion, and arranged so that the issuing gases were cooled sufficiently to prevent the explosion spreading. Gauze protection was first tried, after the manner of a safety lamp, but it was of very little use. After the internal explosion more inflammable air was drawn through and ignited, with the result that what is called "after burning" was set up. Cooling by means of long tubes and labyrinth protection had also been abandoned. With plate protection, Mr. Sheldon explained that its efficiency was completely destroyed if any single fault occurred, such as too large a gap between any of the plates, so that it was advisable to test the plant before installing. In some United States (Bureau of Mines, 1913) explosions, the plate protection failed when a fan was fitted to the motor. Flames were discharged through the holes in all cases, when the fan was used, but never when the fan was not running. That was to say, as long as the fan kept drawing into the motor fresh gas to be ignited, it was impossible, with a reasonable size, to have sufficient cooling effect at the plates.

The most usual method applicable to all kinds of apparatus was flange protection. Broad flanges were used at each joint, and these were only roughly machined so as to allow 1/2,000 or 1/1,000 in. clearance for the escape of gas; otherwise, relief valves had to be fitted. The flanges must be wide enough to cool the gases below 650° C., even if "after burning" occurred. The apparatus must have great mechanical strength and be able to stand at least 100 lb. of internal pressure.

The Paper next dealt with haulage. The simple use of tubs on rails was the usual method; but in the thin seams

there was no room for the tubs in the actual stalls, and so conveyors came to be used. A conveyor could effectively remove all the coal along a face of from 60 to 100 yards. The fewer gate roads were a great advantage, as the cost of maintaining headings was great. Steam and compressed air had long been used for haulage purposes underground. The disadvantages of steam pipes in the shaft or boilers underground had caused attempts to be made to work from surface machinery by band-ropes on guide pulleys in the shaft. Compressed air was inefficient, and could only be used for comparatively small powers and in fiery places. Electricity was fast displacing all other methods, and was much cheaper in working than steam. There had recently been a development also in the use of small portable haulage gears to draw the coal out of the gates, and to do away with ponies.

Electric winding gave great reliability, and very exact control was possible, both at the winding speeds and at the low speeds necessary for the extension of shafts and ropes. In addition, it gave every possible safeguard to life. The emergency brakes were usually actuated by a weight held off by compressed air, the compressor being driven by a small motor. The stop valve of the compressed air supply was kept closed by a solenoid, and thus any failure of the current or air applied the brakes. Overwinding was prevented by the depth indicator releasing the brakes, and any increase of speed above the safe limit could also be made to apply the brakes by means of a centrifugal switch. The use of a balance rope was much more possible with an electrical winder. As the total output of the pit was limited by the winding capacity, the problem was to accelerate a heavy mass, consisting of cages, trucks, ropes, pulleys, and coal, to a speed of some 40 miles per hour, in perhaps 20 seconds, to maintain this speed for a very few seconds, and then to reduce the whole mass to rest in a few seconds more. The power necessary to do this was nearly double that which was required during the free running period, and during the braking period the power demand, of course, suddenly ceased. If power were taken directly from the supply station to the winding motor, the station must be of enormous size, and hence the need of the various well-known types of electric winding equipment.

A Cadmium Vapour Lamp.—A Paper on a cadmium vapour lamp was read before the Physical Society by Dr. J. S. Sand on Feb. 11th. We have already published a brief note on this lamp on Sept. 16th, 1915 (Vol. XI., p. 380). It is for laboratory purposes, the use of cadmium lines being convenient in polarimetric work. A quartz glass is employed with lead seals. The metal is melted by a Bunsen burner before starting, and the arc struck by tilting the tube. The principal difficulties to overcome were in removing the dissolved gases and oxide from the glass (which is done by a process of filtration in a vacuum), and in preventing the metal from adhering to the glass. A small amount of zirconia powder is introduced for the latter purpose, and spreads itself over the surface of the metal.

"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Feb. 24th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

1,087/15. **Telephone Systems.** J. E. Cooley. A telephone system comprising an automatic switch operated over the two sides of the line in series for extending a connection from a calling party to a called party, in which, when an attempt is made to establish connection with a busy called line, the connection between the calling line and the automatic switch is opened whilst the calling subscriber's receiver is off the hook, so as to cause the automatic switch to be released. (Two figures.)

2,624/15. **Rotors.** Sunderland Forge and Engineering Co., R. G. Scott, and A. T. Robertson. End rings for short circuited rotors and equalising rings for D.C. armatures, &c., of special form, with blades thereon, so that they also act as ventilating fans. (16 figures.)

5,768/15. **Distribution.** I. Frankenburg & Sons, Ltd., and R. Fleming. A system of low-voltage lighting, consisting in placing in a high-voltage circuit an auxiliary resistance, such as one or more high-voltage lamps in parallel with a number of low-voltage lamps in series, each small lamp being provided with a small shunt resistance. (Two figures.)

12,340/15. **Motor Control.** British Westinghouse Electric & Manufacturing Co., Ltd. A control system for A.C. motors with a limit switch to regulate the acceleration provided with two actuating coils, one of which is connected to the motor circuit throughout operation, and the other to an auxiliary source of supply during acceleration only. (16 figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: A.E.G. [Tungsten arc lamp] 8,272/15.

Dynamos, Motors and Transformers: Suchostawer [Transformer motors] 17,851/14; Torner [Transformer] 2,786/15.

Electrometallurgy and Electrochemistry: Perreur-Lloyd [Electrolytic production of zinc] 4,681/15; Imray (*Society of Chemical Industry in Basle*) [Electrolytic reduction of oxidising organic substances] 15,750/15.

Heating and Cooking: Readett [Heating tools] 2,894/15.

Instruments and Meters: Nield [Meters] 2,390/15.

Storage Batteries: Haworth [Accumulators] 2,045/15.

Switchgear, Fuses and Fittings: Igranic Electric Co. (*Cutler-Hammer Mnf. Co.*) [Switch panel] 2,180/15; Brown [Motor starters] 2,356/15; Broughton [Conduit fittings] 4,110/15; Moore [Switch plugs] 6,642/15; Burdon (*Siemens-Schuckert werke*) [Fuses] 8,412/15.

Telephony and Telegraphy: International Electric Co., Le Noir, and Funccius [Telephone exchanges] 3,366/15.

Traction: W. R. Sykes Interlocking Signal Co. [Signal relays] 9,246/15; Reik and Oesterreichische Daimler Motoren Ges. [Electromechanical driving arrangements] 14,548/15.

Miscellaneous: Lancashire Dynamo & Motor Co. and Hargreaves [Planing machine drive] 1,774/15; Forrester (*Dunham*) [Portable lamps] 2,489/15; Quartzlampen Ges. [Mercury vapour lamps] 7,003/15; Jeans & Jeans, Ltd. [Advertising devices] 7,622/15; Burdon (*Siemens & Halske*) [X-ray apparatus] 7,868/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Telegraphy and Telephony: Naamlooze Vermootschap de Nederlandsche Thermo-Telephoon Maatschappij [Wireless telegraphy and telephony] 3,954/15; J. Bethenod and E. Girardeau [Radio-telegraphy] 1,597/16.

Opposition to Grant of Patents

The grant of a patent has been allowed on the following application in spite of opposition :—

2,865/15. **Magnetic Separator.** A. J. Newell and R. J. Marx. An electromagnetic apparatus for extracting fragments of magnetic material from pulp during the process of the manufacture of paper.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years :—

5,530/02. **Meters.** C. H. Merz. A discontinuously integrating meter in which the counting train is advanced by an amount proportional to the deflection of a direct reading indicator instrument.

5,81?/02. **Liquid Starters.** J. H. Wooliscroft. A drum-type liquid motor starter, which can be fitted with no-voltage and overload releases. (This is known as the "Sandycroft" starter. See Electrical Engineering, Vol. I., page 66.)

The following are the more important patents that have become void through non-payment of renewal fees.

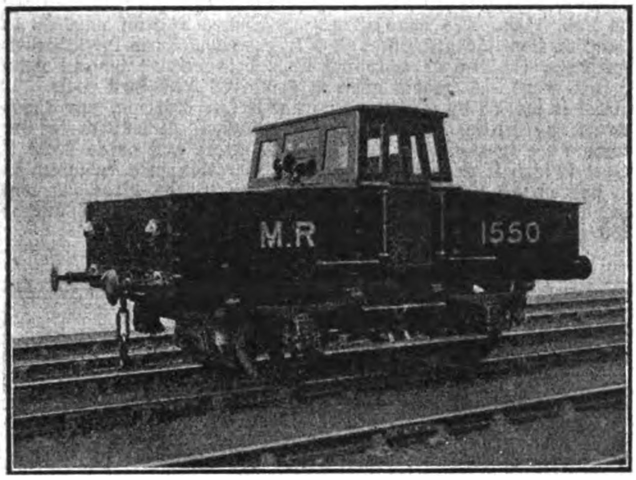
Dynamos, Motors and Transformers: H. A. Mavor and Mavor & Coulson [Fan-ventilated motors] 26,005/09; A.E.G. [Single-phase motors] 26,046/09.

Switchgear, Fuses and Fittings: B.T.-H. Co. [Magnetic blow-out circuit-breaker] 24,285/03; T. E. Morris [Fuses].

Telephony and Telegraphy: A. Ekstrom [Telephone exchange system] 24,637/02; C. M. Jacobs [Party line system] 22,820/05.

ELECTRIC TRACTION NOTES

The battery locomotive illustrated is one that has been in use on the Midland Railway for some eighteen months for shunting and sorting coal traffic in the West India Dock Depôt, London. High speeds are, of course, unnecessary, and the rated speed is seven to twelve miles per hour, a maximum load of six 15-ton loaded wagons and twelve 6-ton light wagons being dealt with. The weight complete with battery is 17½ tons, and the rigid wheel base is 8 ft. 6 in. There are two 22-h.p. Dick Kerr motors, mounted one on each axle. The battery is by the D.P. Battery Co., of Bakewell; it consists



of 108 cells, with a total capacity of 300 ampere-hours at a normal discharge rate of 40 to 90 amperes. This battery has been in daily service for eighteen months, and, in spite of the severe jolting to which it is liable in shunting service, it is stated to have given every satisfaction. The mechanical portions of the locomotive, such as the wheels, axles, drawgear, &c., are largely constructed of standard wagon parts.

The difficulties with regard to the contracts for the London, Brighton & South Coast Railway Co.'s electrification schemes, referred to in some detail in this column last week, was mentioned at the annual meeting on Feb. 23rd. The work, however, is now proceeding, although at a considerably slower rate than would have been the case normally, and in connection with the electrification scheme generally it is interesting to note that the number of passengers carried on the electric lines in 1915 was nearly 70 per cent. more than in the last years of steam traction. The increase is still continuing, as the number of passengers carried last year was 15 per cent. more than in 1914.

Owing to the difficulties in obtaining the necessary electrical plant, the electrification of the part of the North London Railway which is involved in the greater scheme for the electrification of the London & North-Western suburban lines is being delayed. Lord Rathmore, at the annual meeting last week, however, stated that the company has all the money necessary for the scheme, and that by September it was hoped to work the service between Broad Street and Kew and Richmond electrically.

The London & North-Western Railway Co. last year advanced a further £143,500 to the London Electric Railway Co. as part of the £1,000,000 which is to be lent in connection with the construction of the extension already completed from Paddington to Queen's Park. The total amount now advanced is £642,416. At the meeting last week it was stated that the company anticipates spending £928,000 this year upon the Euston-Watford electric railway.

At the annual meeting of the London & South-Western Railway Co. last week it was stated that although only a portion of the company's electrification scheme is yet in operation, the number of passengers carried on these lines shows an increase of 16 per cent. compared with those carried just prior to the inauguration of the electrical services.

"Sell's Directory."—All the old-established and well-known features appear in the 1916 edition of "Sell's Directory and Telegraphic Addresses." Many new trade headings have been opened, and this is specially noticeable as regards the chemical industry. There are in all 3,400 separate trade headings, 100,000 firms being represented.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

A long Paper describing the Western Electric Co.'s semi-automatic telephone exchange system in great detail was read by Mr. J. Hedley before the Institution of Post Office Electrical Engineers on Feb. 14th. In the semi-automatic system the operator is not dispensed with, and the subscriber removes his receiver from the switch-hook and gives his requirements to an operator as usual. The calls, however, are automatically and evenly distributed to the operators instead of there being an operator for each group of subscribers; the operator then, on hearing the number required, simply presses number buttons, and the call is from that point operated automatically if it is for the same exchange, and the clearing is effected by the depression of a "release" key by the operator when both supervisory lamps glow. In the case of junction calls, an "office" key is depressed by the operator before the digit buttons, and an idle junction is automatically found and the number displayed on a dial in front of the B operator at the other exchange, thus saving any delay on an order wire. Some of the circuits and apparatus are the same as the W.E. Co.'s full-automatic exchange, described in our issue of Oct. 22nd, 1914 (Vol. X., p. 550). The call is "stored" if it cannot be put through immediately owing to all the switches or junctions being occupied, and the operator is aware of this, and can speak on the line and explain matters to the subscriber if the delay is long. In the automatic distribution of the calls to the operators, it is arranged that four seconds is the minimum time between the receipt of successive calls by the same operator, and, in addition, each operator is provided with a "helping out key," which enables her to relieve pressure on adjacent positions at any time her own register is free. In the exchange on this system at Landskrona (Sweden) it was found, for instance, on a test between 10 and 11 a.m., that Position 1 carried 506 calls, including 66 helped out from Position 2, while Position 2 carried 507 calls, including 71 helped out from Position 1. A useful feature of the system is a "hold-over" key, which enables an operator to hold an automatic switch which is not working properly and transfer it to the test clerk for test; this eliminates much of the maintenance routine necessary on a full-automatic exchange. In the introductory part of the Paper it was mentioned incidentally that the system of "ancillary jacks," to facilitate team working, installed at the new "Avenue" exchange in 1912 (ELECTRICAL ENGINEERING, Vol. VIII., p. 13), and subsequently in five other exchanges, had conduced to little saving except by the means it afforded for concentration at slack periods, and, in the author's opinion, the same would be the case with the method of automatic distribution of calls to an idle operator, without eliminating the answering and calling plugs, installed at Paddington more recently (ELECTRICAL ENGINEERING, Vol. IX., p. 306). The Paper was well received. Mr. Stubbs endorsed the Author's view that, for a proper trial of the system, a large exchange should be equipped, as the main question to determine would be the improvement it brought about in traffic efficiency. Mr. Anson discussed the circumstances in which a semi-automatic system should be introduced and the subscriber's attitude towards the full automatic, and he also thought that the Author had not quite done justice to the traffic distributor at Paddington in his brief reference to it. Mr. Turner referred to a few matters of technical detail, objecting incidentally to the use of supervisory relays with break action, and also referred to the difficulties in Chicago, where there was an automatic system and a competing manual system side by side. Mr. Kennedy expressed the hope that Mr. Hedley would be able to infect with his progressive ideas those of his colleagues who had to deal with private branch exchanges; and Mr. Deakin said that the "carriage call" system—the method described in the Paper for dealing with junction calls—was in successful use on a 3,500-line exchange at Newark (U.S.A.).

According to a *Reuter* telegram from Montreal, telephonic communication has been established between Montreal and Vancouver (B.C.), a distance of 4,300 miles.

"Hazell's Annual."—The 1916 "Hazell" contains its usual vast store of information. Naturally special attention is given to details appertaining to the war, most of the new Government staffs which came into being during the past eighteen months being given, and much space being devoted to naval, aviation, and military matters.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

QUESTION No. 1,484.

I am in charge of a shunt-wound D.C. generator supplying current to a small light installation. The voltage is 220. There was an accidental short-circuit in the cables leading to the brushes. The voltage at once fell down to zero and began to build up again to its normal voltage, but with the polarity now changed. Why is this?—R. H.

(Replies must be received not later than first post, Thursday, March 9th.)

ANSWERS TO QUESTION No. 1,482.

Give a rule for calculating the following windings: (*a*) for no-volt coils for use on A.C. switchgear; (*b*) solenoid-operated oil switches; (*c*) for use on brakes, &c. A frequency of 50 cycles to be assumed, but state what difference, if any, would be required for 60 cycles per sec.—W. E. L.

The first award (10s.) is made to "L. R." for the following reply:—

Many difficulties arise in designing A.C. electromagnets, due to the varying induction in the iron, allowances for leakages and so on, so that in practice most of the design is based on experiments. Coils are made up in sizes known from experience to be outside the range, and then correction factors taken from tables are used on the results of the test coils. The following rules, however, give the basis of the original calculations. The law underlying all designs is expressed by the equation: $= \frac{B^2 A}{8\pi}$

where P = pull in dynes, B inductance in lines per sq. cm., and A area in sq. cms. Where P is in lbs., B in lines per sq. in., and A in sq. ins. it becomes approximately

$$P = \frac{B^2 A}{72 \times 10^6}$$

No-volt Release.—In this appliance the armature is positively moved against the action of a spring into contact with the magnet poles. No air gap, therefore, has to be considered, so the above law can be applied as it stands. Assume the spring tension is 4 lb., and it is decided to use a good quality sheet steel, which from its curves has B = 130,000 (sq. in.) for 150 ampere turns per inch length.

Then: $$A = \frac{P \times 72 \times 10^6}{B^2} = \frac{4 \times 72 \times 10^6}{130 \times 130 \times 10^6} = 1\cdot 7 \text{ sq. ins.}$$

This gives the section of iron necessary.

Now assume we can have a magnetic circuit of length 5 in., we shall require $5 \times 150 = 750$ ampere turns—say, ½ ampere and 1,500 turns. Reckoning the length of mean turn at 6 in., this means 750 ft. of wire—say No. 24—giving a resistance of 16 ohms.

In alternating-current work the inductance is usually of greater effect than resistance, hence this must be calculated. The formula is:

$$L = 4\pi \times \text{area} \times S^2$$

where area is in sq. cms. and S the number of turns, dividing the result by 10^9 to bring it to practical units. Thus

$$L = \frac{4\pi \times 18\cdot 4 \times (1500)^2}{10^9} = \cdot 52$$

With a frequency of 50 the reactance

$$Lp = \cdot 5 \times 50 \times 2\pi = 25 \times 2\pi = 157.$$

Now $$C = \frac{E}{\sqrt{R^2 + L^2p^2}} \text{ or } E = C\sqrt{R^2 + L^2p^2}$$
$$= \tfrac{1}{2}\sqrt{(16)^2 + (157)^2} = 80 \text{ about.}$$

That means that the no-volt coil would hold the arm until the E.M.F. dropped to 80 volts. In practice this would be correct for a 200-volt, but too high for a 100-volt starter. It should release at about 40 per cent. voltage, or the motor might be damaged by a sudden switching on of full voltage. In any event the design is only approximate, as no allowance has been made, say, for leakage and for the fact that a very slight gap is always used between paper and poles to prevent remanent magnetism holding the armature.

Solenoid-operated Switches.—In this type of apparatus a plunger moves inside a coil, and it is most difficult to calculate sizes with accuracy owing to the many variables introduced, such as the action of the coil itself as distinct from the core. The field at the centre of an air solenoid,

$$H = \frac{4\pi}{10} \cdot \frac{CS}{l}$$

where l is length in cms. and H is in lines. Say the same iron as before is used and that it requires $H = 50$, also that l can be reckoned as 8 ins. = 20·3 cms.

Then $$CS = \frac{H \times 10 \times l}{4 \times \pi} = \frac{50 \times 10 \times 20\cdot 3}{4 \times \pi} = 810.$$

As before, we can choose what ratio between current and turns is considered desirable so long as the product is 810, and can arrive at the voltage, or, given the voltage, can estimate current, turns, &c.

Brakes.—In this case we have to deal with a magnetic circuit comprising a core, two air gaps, and a track rail, say. In practice most of the ampere-turns are required to send the necessary flux through the gaps, so the rest of the circuit can be disregarded at least for a first approximation. The ampere-turns for the air are obtained from the equation

$$H = \frac{4\pi}{10} \cdot \frac{CS}{2l}$$

where l is the length of each gap. After the desired pull has been settled and an approximation to the area made, Maxwell's law will give H, because for air $B = H$. By substituting in the above equation, therefore, CS is found.

Varying Frequency.—Increase of frequency in any case will decrease the pull. The amount of change depends on the inductance of the coil, and the effect can be seen by substituting, say, 60 for 50 in the first example. In that case the value of E for the same pull would be increased by about 15 volts.

No second award is made.

ANSWERS TO QUESTION No. 1,480.

"DYNAMO" writes us: "In his criticism of my answer to Question No. 1,480, 'W. H.' himself makes one or two mistakes, I think. As regards the brush shifting, as you yourself pointed out, the drop in voltage is only partly due to the extra demagnetising force. Now, with regard to the question of instability when the machines are paralleled, this is, I think, a matter of speed variation rather than any inherent irregularities in the machines themselves. As is well known, a machine is very sensitive to speed fluctuations unless it is working well above the knee of the curve. 'W. H.'s' argument on this point does not seem very satisfactory, for, with machines with rapidly falling characteristics, it should be quite a simple matter to run them in parallel, other things being equal. The equalising connection is only wanted when the machines have their series coils correctly connected—*i.e.*, when the voltage tends to rise with increase of load. As regards the high voltage on no-load, I still think my explanation is correct, because it is obvious that the resistance of the shunt circuit is too low, and, as 'W. H.' himself says, it is unlikely that both field rheostats are short-circuited. 'W. H.'s' explanation puzzles me somewhat, as it is not quite clear what the series turns can do when they are carrying no current."

[Both our correspondents agree as to the remedy which should be adopted to cure the trouble explained by "Booster," who is doubtless grateful for their assistance. We have indicated our own appreciation of the different ways in which they have explained the phenomena observed, by selecting their replies (out of an unusually large number received) for the 1st and 2nd awards. Now that each has had the opportunity of criticising the other—a course which we should not have permitted had their letters been less interesting—we are content to close this correspondence and incidentally to refer "Dynamo" and "W. H." to the last five words of the "Rules."—ED., *E.E.*]

ANSWER TO CORRESPONDENT

P. J. W.—Your questions are hardly suitable for competitive replies. We should advise you to study a textbook such as "Magnetic Induction in Iron and Other Metals," by Sir Alfred Ewing. We can supply you with a copy of this for 10s. 6d. post free.

PROJECTORS, ALSO REFLECTORS FOR DOMESTIC AND STREET LIGHTING

On Wednesday last week Lieut. Haydn Harrison, R.N.V.R., read a Paper on "The Efficiency of Projectors and Reflectors," before the Liverpool Engineering Society. He first explained that increasing the current in an arc lamp increased the candle-power by increasing the area of the crater. In order to gain any advantage by this increased area of light source, it would be necessary to use larger projectors; otherwise the angular spread or "divergence" of the beam would be increased and all gain as regards intensity of beam would be lost. When using a 90-cm. mirror and a lamp taking 150 amp. producing a crater of 23 mm. in diameter, the angular divergence of the beam was rarely less than 2° or a spread of 4°. Such a lamp is generally operated with a mirror, of which the focus is half the diameter. Thus the intensification factor of such a searchlight works out as follows :—

$$\text{Intensification} = (1 - \cos 45°)/(1 - \cos 2°) = 500,$$

which, with an ordinary arc giving 50,000 candle-power, represents a beam power averaging 25,000,000 candle-power illuminating value. In order to improve on these conditions it was necessary to produce a light source giving equal or more candle-power from an area equal to or less than the present crater; in other words, to approach as closely as possible to the theoretical point source.

In an arc lamp where the light is derived from the crater the heat produced electrically is dissipated largely by radiation; thus the crater is only at its maximum temperature at the centre. The use of small carbons to increase the current density would result in the carbon becoming more heated all over and volatilising away rapidly so as to form a pointed end; therefore, the only way was to cool the outer surface of the carbon. Means have been found for doing this, and the diameter of the core for the same current has been reduced to nearly one-third of the original figure. A further advantage has been gained by embodying in the core certain ingredients such as are used in flame carbons, with the result that not only is the diameter of the crater reduced in the proportion stated, but the candle-power is also increased. With this reduced area of light source, the angular spread can be reduced to 2°. for which the intensification factor is 1,952. The lamp produces double the light, thus the useful illuminating power of the combination is nearly eight times that of the searchlight used hitherto.*

The author has also been experimenting with gas-filled incandescent lamps, with the object of concentrating their light for certain other purposes. Each step in the improvement of the efficiency of incandescent lamps has led nearer to the point where their intrinsic brilliancy demands that, to prevent glare, the light source must be shaded or diffused, and this should be carried out in such a manner that the gain in lamp efficiency is not lost by the process. Fortunately, the very cause of the increased intrinsic brilliancy, viz., the reduced area of the light source, is an aid to efficient reflection; and the author hopes that, as the lamp-makers have found it an advantage to make the filaments of gas-filled lamps of very close coiled wire, they will also find it an advantage to place these coils together so as to concentrate the light source. With a 6-volt 108-watt lamp it is possible to produce a reflector giving seven times the multiplying power obtainable when using a 100-volt lamp under the same conditions, the spread in the latter case being more than double.

Totally indirect lighting, the author continued, has not come into general favour, but the fact that semi-indirect lighting has met with approval indicates that there is something to be said in favour of indirect lighting. Assuming that in indirect lighting the efficiency of the reflectors was good, and that 70 per cent. of the luminous flux was concentrated on the ceiling, and the reflecting value of the ceiling was 70 per cent., thus allowing about 50 per cent. of the original light for illuminating the objects in the room, this 50 per cent. was being diffused from a reflector which distributed it in all directions in the lower hemisphere; therefore the luminous flux was divided over an angle of 180°. In most rooms the bulk of the light is required over an angle of 90° when the light source is high up; therefore, of the original light produced only about 15 per cent. would be used, as will be seen from the following calculation, where 0·5 represents the 50 per cent. of the original luminous flux :—

$$\text{Luminous flux used} = 0{\cdot}5\ (1 - \cos 45°)/(1 - \cos 90°) = 0{\cdot}146.$$

* A description of the Beck lamp, embodying these principles, appeared in Electrical Engineering, of Feb. 25th, 1915, Vol. XI., p. 81; see also Jan. 28th, 1915, Vol. XI. p. 35.

A semi-indirect fitting would have been more efficient, as some of the light, say 30 per cent., would have been allowed to pass into the required direction through a diffuser, but the efficiency, though higher than with the indirect system, would still be very low.

Nature, far from producing a diffused light when under the most pleasant conditions in summer-time, provides a light radiating from one powerful source. It is true that in dull weather, when the sun is clouded over, the light is more diffused, but these conditions are depressing, and should not be imitated in artificial lighting. It appears to be the general impression that the sole cause of glare is the high intrinsic brilliancy of a light source. In the author's opinion this is not so, for the following reason :—If a ten-inch diameter motor-car headlight, producing, say, a maximum of 5,000 candle-power, is compared with an arc lamp which, when enclosed in a ten-inch opalescent globe also gives 5,000 candle-power, the headlight will appear to be much more glaring. The difference lies in the fact that the apparent intrinsic brilliancy of the source tapers off in one case to nothing, whereas in the case of the headlight it ceases nearly abruptly.

Mr. Harrison next criticised the usual types of reflector, and advocated the employment for domestic lighting of a form giving a much more concentrated light, supplemented by a small bowl beneath the lamp to give the desired diffusion. In his work in the Navy, he said, he has been able to produce reflectors which, with a dispersion of 6°, produce a mean candle-power about 1,000 times that of the original lamp.

The concluding portion of the Paper dealt with street lighting. The author maintained that the distance at which an object is visible from a motor-car using a headlight of quite moderate power is in itself proof that the lighting of roads could be more efficiently carried out without increasing the cost. A 32-candle-power lamp provided with a suitable reflector will produce a beam by which a dark-coloured object can be seen at a distance of 750 ft. That is to say, with lamps 250 yards apart, illuminating conditions could be produced which would ensure public safety; whereas the conditions now are such that with lamps of similar power placed 70 yards apart the illumination is so bad that traffic is often dangerous. It is, however, common knowledge, he continued, that the headlights of vehicles produce an effect of glare which might prove a serious drawback to the adoption of concentrated light for street or road lighting purposes. In the case of public lighting this can be reduced by placing the light sources at such a height that the most powerful rays are only within the line of vision when the lamps are viewed from a distance, and he therefore gave the following example of a scheme for street lighting in accordance with his ideas :—

Take a road 50 ft. wide, which it is desired to illuminate up to the standard of 0·1 foot candles minimum horizontal illumination. If two lamps be used at each lighting source fitted with reflectors of the projector pattern, it will be found that, with a spacing equal to 100 yds. between each post and the lamps placed at 20 ft. above the ground, the following candle-power of the beam is required (approximate) :—

Over an angle of 20 degrees	(1,750 lumens)	17,500 C.-P.
,, ,, 20 to 27 degrees	(350 ,,)	5,500 ,,
,, ,, 27 to 45 ,,	(125 ,,)	800 ,,

Note.—These figures must be halved, as two lamps are covering the same ground from opposite directions.

With a reflector correctly designed this result could be produced with a lamp giving 93 mean spherical candle-power, or, allowing for losses in reflectors, say, a 125-candle-power lamp. There being two such lamps on each post, the electrical energy required at 0·7 watts per mean spherical candle-power would amount to 175 watts per post. And as there would be only 17 posts to the mile, the total energy required per mile of lighting would be under three kw.

To compare this with the most efficient of the present systems, one might take the case of a 500-watt flame arc lamp using a dioptric globe and giving 2,500 candle-power in the required direction. In order to obtain the same minimum illumination these would have to be placed about 60 yards apart. This would represent 30 to the mile, or 15 kw. per mile of lighting. Moreover, these being arc lamps, they would cost considerably more to instal and maintain.

Meetings of the Tramways & Light Railways Association and the Incorporated Municipal Electrical Association.—The Tramways & Light Railways Association have decided to hold their Annual Conference on June 30th in order not to clash with the Annual General Meeting of the Incorporated Municipal Electric Association, which has been provisionally fixed for Thursday and Friday, June 22nd and 23rd.

HALF-WATT LAMPS TO REPLACE ALL THE ARCS IN NEW YORK

According to the *Electrical World* of New York, all arc lamps in the City of New York are to be replaced with large-sized gas-filled tungsten units under the terms of the contracts entered into for 1916 with the different lighting companies supplying the city. Tenders for supplying different parts of the city have been accepted from the New York Edison Co., the United Electric Light & Power Co., the Bronx Gas & Electric Co., the Westchester Lighting Co., the Edison Electric Illuminating Co. of Brooklyn, the Flatbush Gas Co., the New York & Queens Electric Light & Power Co., the Queensboro' Gas & Electric Co., and the Richmond Light & Railroad Co. The amount of money which the city is authorised to spend for the lighting of streets, parks, and public places for 1916 is $3,022,543, divided as follows among the different boroughs:—Manhattan and the Bronx, $1,285,782; Brooklyn, $1,075,685; Queens, $493,076; and Richmond, $168,000.

The new gas-filled units will range from 100 c.p. to 400 watts in size, and the vacuum type of lamps from 40 watts to 100 watts.

During the year 1914 the city discontinued the use of the flame-arc lamp. Beginning with 1915, there were in service 18,211 arc lamps, many of which during the year were replaced with gas-filled tungsten incandescent units. In 1916 the remainder of the arc lamps will be replaced. The prices which the city will pay for the new incandescent units will mean a saving in the larger sizes of approximately $10 per lamp per annum over the arc lamps they will replace. Besides the saving to the city in dollars and cents, it was found, after a careful investigation and comparison of the gas-filled tungsten units with the arc lamps, that the gas-filled unit afforded a more uniform distribution of light, without glare or flicker, and has a much greater penetrating power in stormy or foggy weather.

EDISWAN COLONIAL SHOWROOMS

The Edison & Swan United Electric Light Co., Ltd. (Ponders End, Middlesex), was one of the first to recognise the importance of having well-fitted and well-stocked showrooms in the Colonies, and the results so far have been very satisfactory. In spite of German "frightfulness," and the general disorganisation to shipping, high freight charges, &c., the Ediswan Australian showrooms make a very fine show, and their rapid progress enables us to publish two photographs of the Melbourne showrooms, which give a good idea of the extent of the building and the class of articles that find a market in this Colony. It will be seen in the photograph that amongst other familiar

Interior of Ediswan Melbourne Showroom.

articles are luminous lamp radiators, Bastian patent heaters, fans, holophane glassware, &c., &c.

As many firms connected with the electrical and allied trades have branches in Australia, &c., we give below a list of the Edison & Swan United Electric Light Co., Ltd., Colonial depôts and Principal Agencies, with the hope that they may be of assistance when this firm's branded or agency goods are required.

Australia:—*Sydney:* 58 Clarence Street. *Brisbane:* 32-4 Adelaide Street. *Melbourne:* 368 Little Collins Street.

Sub-Agencies:—*Adelaide, S.A.:* Newton McLaren, Ltd., Leigh Street. *Perth, W.A.:* Unbehaun & Johnstone, Ltd., 261 Murray Street.

New Zealand:—*Wellington:* 19-23 Blair Street. *Napier:* Shakespeare Road. *Auckland:* Shortland Street. *Gisborne. Christchurch:* 77 Cashel Street. *Invercargill. Dunedin:* 80 Stuart Street. Messrs. Turnbull & Jones are the representatives in each case.

South Africa, Rhodesia, Delagoa Bay, and Beira:—Griffin Engineering Co., Silesia Buildings, Main Street, Johannesburg.

Ediswan Melbourne Showroom.

Malay and Straits Settlements:—Berry & Co., Ipoh, Perak.

India and Burmah:—Balmer, Lawrie & Co., Ltd., 103 Clive Street, Calcutta.

CATALOGUES, PAMPHLETS, &c., RECEIVED

HOLOPHANE GLASS WARE.—A new list by Holophane, Ltd. (12 Carteret Street, S.W.), of electric-light fittings deals with a very complete collection of every class of electric-light fitting to which the word "ornamental" can be applied. The feature of all of them, of course, is the use of Holophane glass. Brackets, standards, reflector bowl pendants, ceiling fittings, sphere pendants, and electroliers in all the well-known period styles are dealt with. Architects and consulting engineers will find the catalogue specially useful.

LAMPHOLDERS.—A pamphlet from G. G. St. John Day (Patents), Ltd. (Bank Mill, Morton Street, Oldham), illustrates and describes various forms of lampholders which can be wired without tools. We illustrated one form on p. 18 of our issue of Jan. 13th.

Engineering and Public Policy.—The B.E.A.M.A. is organising a series of meetings in the principal industrial centres of the country with a view to demonstrating the need for careful thought on the part of the engineering trade generally as to the methods for dealing with the position after the war. The first of these meetings was held in Birmingham on February 23rd, when Mr. T. C. Elder delivered an address on "Engineering and Public Policy." At the same time, Mr. Elder made it clear that what he said was not an official announcement on behalf of the "B.E.A.M.A.," but represented his own personal opinion. The address covered points which Mr. Elder dealt with in his Paper at the "B.E.A.M.A." dinner in December last, namely, that unless special care is taken, the present large surplus of machine tools and general engineering productive machinery, as compared with ordinary peace times, will result, when the war is over, in the biggest national scrap-heap ever witnessed. To prevent this, there must be the biggest effort ever recorded in industrial reorganisation. Mr. Elder endeavours to take a half-way view between those who think that very hard times must of necessity follow the conclusion of peace on the one hand, or that there will be such an influx of orders that there is no need to trouble now to any great extent as to the future. He believes that there will be a financial crisis continuing after the war during which the potential supply of engineering and hardware manufactures will greatly exceed the demands, and to counteract this he argues that timely and sweeping reforms must be made in our trade policy.

LOCAL NOTES

Birmingham: *Electric Supply Profits.*—It is estimated that the Electric Supply Department will be able to contribute £25,000 for the financial year ended March 31st, as against £35,000 in the previous twelve months. The cause of this drop in profits is the extra cost of coal, material, and labour.

Dublin: *Electricity Undertaking.*—A special meeting of the Electricity Supply Committee has unanimously decided not to send any estimate to the Council of the results for the year 1916–17. Mr. Mark Ruddle, Borough Electrical Engineer, and Mr. Allan are to report as to the cost of coal, carbons, &c.

Middlesbrough: *Further Bulk Supply.*—The arrangements which have recently been made with the Cleveland & Durham Electric Power Co. will effect an annual saving of £500 or £600, and defer for some years a further expenditure of several thousand pounds.

Sunderland: *Increase of Charges.*—A scheme for increasing the charges for electricity supply, except in the case of the trams and power-users where contracts exist varying the price of current in accordance with the price of coal, has been prepared. If adopted, it will come into force from the March quarter, and increases the charges by about ½d. per unit.

APPOINTMENTS AND PERSONAL NOTES

Mr. Andrew Nance has tendered his resignation as General Manager of the Belfast City Tramways. It is understood that the Tramways & Electricity Committee will recommend that Mr. Nance be appointed Consulting Engineer at a salary of £500 per annum.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Electrical Distribution of Yorkshire.—The net profit for 1915 was £3,638, compared with £2,964 in 1914. After paying 6 per cent. on the ordinary shares, and adding £4,000 to reserve, the carry forward is £1,031. The strong position of this company, it is pointed out, is due largely to its close association with the Yorkshire Electric Power Co.

Yorkshire Electric Power Co.—At the annual meeting on Tuesday of last week, the report and accounts as given on page 62 of our issue of Feb. 17th were adopted. Mr. A. J. Lupton, the chairman, expressed the regret of the Board that a higher dividend could not be paid upon the ordinary shares, and in doing so pointed out the necessity in these difficult times for consolidating and securing the resources of the company. In this connection he pointed out that the addition of £7,500 to the reserve fund now brings this to £20,000.

Mather & Platt.—At the annual meeting on Wednesday last week, a 12½ per cent. dividend, less income-tax, was declared for 1915. Sir William Mather, however, mentioned that the accounts did not take notice of the work done for the Government, upon which a small profit was anticipated. He urged both capitalists and labour to do everything possible now to make arrangements to work amicably after the war, as, no matter how big a victory from the military and naval point of view we might achieve, disunion on the industrial side would spoil everything. Sir William suggested that co-partnership schemes were the best solution for all the disputes between capital and labour.

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £135 to £137 (last week, the same).

The "Batti-Wallahs."—In spite of the inclement weather on Friday, one hundred "Batti-Wallahs" and their friends gathered together at the Victoria Mansions Restaurant for an informal dinner. A large proportion of the audience were clad in either blue or khaki, and the excellent programme which had been arranged was much enjoyed.

Physical Society.—Professor C. Vernon Boys, F.R.S., has been elected President of the Physical Society for the ensuing year. The Vice-Presidents are W. R. Cooper, F. E. Smtih, Dr. S. W. J. Smith, F.R.S., and Dr. W. E. Sumpner.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Barrow-in-Furness.—Twelve months' supply of electrical stores. Borough Electrical Engineer. March 6th.

Bolton.—So many applications are being received for power supplies that new plant will have to be installed. A Special Committee has been appointed to go into the whole question with the Finance Committee.

Dundalk.—Twelve months' supply of cable, accessories, wires, service accessories, incandescent lamps, meters, &c. Borough Electrical Engineer. March 31st.

Heston and Isleworth.—Twelve months' supply of cables, meters, &c. Surveyor. March 11th.

Heywood.—Twelve months' supply of meters, service joint-boxes, cable and jointing accessories, motors, starting switches, &c. Borough Electrical Engineer. March 15th.

Salford.—Two 1,000-kw. and one 500-kw. rotary converters are required; also two water-tube boilers. Borough Electrical Engineer. March 4th.

Wiring

Swansea.—Electric lighting of Brynmill and Cwmbwria Schools. Clerk, Education Department. March 6th.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Midland Railway Co.—Pope's Electric Lamp Co., Ltd., have secured a renewal of their contract for the supply of "Elasta" wire lamps and carbon filament lamps.

Slough.—Messrs. Chamberlain & Hookham, Ltd., have received a twelve months' contract from the Slough and Datchet Electric Supply Co. for meters.

Windsor.—A contract for the supply of electricity meters during the coming year has been placed with Messrs. Chamberlain & Hookham by the Windsor Electrical Installation Co., Ltd.

Arrangements for the Week.—*Friday, Mar. 3rd.*—Evening discussion by Prof. S. P. Thompson, F.R.S. "Corona and other Forms of Electric Discharge." 5.30 p.m.

Wednesday, Mar. 8th.—Institution of Electrical Engineers, Manchester Section. Joint meeting with Liverpool Engineering Society at Liverpool University. "Notes on the Modernising of an Electric Power Supply Undertaking," by E. M. Hollingsworth, 7.30 p.m.

Institution of Electrical Engineers, Yorkshire Section, at Philosophical Hall, Leeds. "Hire and Maintenance of Continuous-current Motors," by H. Joseph, 7 p.m.

The War Tribunals.—Although the large majority of men in the electrical industry are employed upon work which is vitally necessary to the output of munitions, and so automatically come outside the scope of the war tribunals, there are a number engaged in various directions in the industry who cannot legitimately claim to be on war work. The War Tribunals in various parts of the country have already had to deal with a number of such cases, in which exemptions have been asked, but they have without exception refused them. Thus, an electrician at a cinematograph theatre at Sheffield, and another at Chorley, have been refused exemption, and an assistant in an electrical engineering business in London has met with the same fate. We hope there are not many more like the twenty-year-old electrician at the Coliseum—placed in the non-combatant class—who alleged that he would stand by and see his mother killed and his home destroyed rather than abandon his scruples as to fighting. A request by the Yorkshire Electric Power Co. for exemption of a consumers' accounts clerk has been adjourned. The ground of the application was that the varied nature of the contracts with various consumers renders a high degree of training necessary to make the calculations.

London Electrical Engineers (T.F.).—The following promotions are notified: To be temporary Captains, dated February 23rd, 1916, Sec.-Lieut. (temporary Lieut.) T. F. Middleton-Case; Sec. Lieut. (temporary Lieut.) G. R. Madge; Sec.-Lieut. (temporary Lieut.) M. G. Bland.

Sec.-Lieuts. to be temporary Lieuts., dated February 23rd, 1916, H. G. G. Clarke, C. H. S. Evans, W. H. Mather, G. E. Owles, E. C. Levett, T. H. Gotch.

Lance-Corporal A. S. Gill to be Sec.-Lieut. (on probation), dated February 18th, 1916.

ELECTRICAL ENGINEERING

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SUMMARY

The proposals of the Council of the Institution of Electrical Engineers with regard to the expulsion of members who are subjects of enemy countries were severely criticised as not being sufficiently drastic. As a result of a stormy meeting at the Institution last week, a new resolution is to be formulated, going much further than the one proposed by the Council. A full report of the meeting appears on pp. 82–84.

An imaginary conversation, not overheard in Berlin, is reported on p. 84.

An important scheme for linking up all the large electric power works in North-East Switzerland, embracing Basle, Schaffhausen, Lucerne, Zurich, St. Gallen, and the Albula Works near Thusis, will probably be put into effect. The capacity of the works included in the scheme is 228,380 h.p. (p. 85).

Some of the "electrical" exemptions granted by the War Tribunals are mentioned on p. 86.

A proposal made by the British Chamber of Commerce for Spain, to combat the German trade influence in that country, is outlined (p. 86).

The use of the "eye-rest" system for lighting Armstrong-Whitworth's offices at the Walker Shipyard is described and illustrated; and the result of a cinematograph carbon competition is referred to (p. 87).

Among the subjects of specifications published at the Patent Office last Thursday were A.C. motors, storage batteries, electric heating, and switch plugs (p. 88).

Our "Questions and Answers" page this week deals with the testing of an induction motor for wear of the bearings (p. 89).

A new lamp catalogue is reviewed, and some particulars of contracts secured by a British company in China are given (pp. 88 and 89).

Regular readers of "Electrical Engineering" should now ORDER their copies from their newsagents or at the bookstalls at which they customarily buy their weekly copies.

The Government has decided that strict economy in paper is necessary, and, in consequence, to prevent waste, the majority of newsagents and bookstalls will limit their stocks so far as possible to the actual known requirements of their customers. A mere verbal order will, however, be sufficient to ensure that a copy is sent or reserved weekly.

"Electrical Engineering" can also be sent direct to readers by post. Copies are posted on Wednesday evening, and should reach readers in practically every part of the United Kingdom on Thursday (in London, and many other towns, by first post). Orders, with a remittance of 6s. 6d. for one year, 3s. 3d. for six months, or 1s. 8d. for three months, which includes postage (Colonies and Abroad 8s. 8d. per annum), should be sent to the Kilowatt Publishing Co., Ltd., 203, Temple Chambers, London, E.C.

The Leigh Corporation proposes to borrow £18,300 for new plant; lamps are required by the L.C.C.; meters, &c., at Dundee; and stores in various places (p. 90).

Three directors of the Metropolitan Electric Supply Co. have resigned; Mr. Highfield has resigned his position as Engineer and Manager, but is appointed Consulting Engineer (p. 90).

Arrangements for the Week.—(*To-day*) *Thursday, Mar. 9th.*—Institution of Electrical Engineers. "Continuous-current Railway Motors," by E. V. Pannell, 8 p.m.

Tuesday, Mar. 14th.—Institution of Electrical Engineers, Scottish Section, at 207 Bath Street, Glasgow. "Terrestrial Magnetism" (Kelvin Lecture), by Dr. C. Chree, 8 p.m.

Wednesday, Mar. 15th.—Institution of Electrical Engineers, Birmingham Section, at the University. "The Use of Continuous Current for Terminal and Trunk-line Electrification," by N. W. Storer, 7 p.m.

Institution of Electrical Engineers, Students' Section. Adjourned discussion on "Suggested Applications of Science to Warfare," 7.45 p.m.

Thursday, Mar. 16th.—Institution of Electrical Engineers. "The Use of Continuous Current for Terminal and Trunk-line Electrification," by N. W. Storer, 8 p.m.

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

(*To-day*) *Thurs., Mar. 9th:* Shooting for Sections I. and II., and signalling class.

Fri., Mar. 10th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Mar. 11th: Uniform parade, 2.45 p.m. Members will parade with the 4th Batt. Central London Regt., and will proceed by train to Woldingham, where they will be given an opportunity of inspecting the trench-digging.

Members wishing to stay in camp on March 11th at Woldingham must give in their names at once.

Mon., Mar. 13th: Sections I. and II., technical. Sections III. and IV., lashings and trestle bridging. Signalling class and recruits.

Tues., Mar. 14th: School of arms, 6.0 to 7.0 p.m.

Thurs., Mar. 16th: Shooting for Sections III. and IV.

THE INSTITUTION AND ITS GERMAN MEMBERS

THE stormiest meeting ever held at the Institution of Electrical Engineers took place on Wednesday last week. The Council submitted an alteration in the Articles of Association, by which a subject of an enemy country should automatically cease to be a member of the Institution. In spite of the inconvenient hour of the meeting, 5 p.m., no less than 124 members were present, and it was evident, almost at the outset of the proceedings, that the Council's proposal was not considered sufficiently drastic. Indignant protests were made against the President's ruling that no amendment to the resolution could be put, and also against his interpretation of the expression "subject of an enemy country," which, he said, did not include Germans who were naturalised Englishmen even if they had not been de-nationalised as Germans. Ultimately the meeting was adjourned without any vote being taken. It was evident that the meeting would not have passed the Council's resolution in the form which had been drafted, and, as the President ruled that the Articles of Association and the wording of the notice of the meeting precluded any amendment being made, it was recognised that no useful object would be served by merely recording a vote against the Council's proposals. Many members had come up to town from the provinces with the express object of obtaining an amendment to the resolution, and much disappointment was expressed.

It was decided by the President that an informal general meeting of members should be convened to discuss the matter more freely. This informal meeting took place at 5 p.m. yesterday, and we shall publish a full report of it in our next issue.

The following is a report of last week's meeting :—

The President (Mr. C. P. Sparks), in opening the proceedings, explained that he intended to put the proposed alteration of the Articles of Association to the meeting from the chair. Mr. C. A. Baker (London County Council) would second it, and then discussion would be invited. At the same time he remarked, in answer to certain criticisms of the Council that have been made in connection with this matter, that there were stronger feelings in favour of taking action on the part of members of the Council than some of the ordinary members imagined. Before putting the proposed alteration, he pointed out that amendments could not be put, as Article 81 laid down that "no other business shall be transacted" at a special general meeting than that specified in the notice convening the meeting.

The following alteration to the articles was then proposed as an addition to Article 41 :—

"In the event of a state of war arising between the United Kingdom of Great Britain and Ireland and any other country or State, any member of any class who at any time during such war shall be a subject of such enemy country or State shall forthwith cease to be a member of the Institution, and in the case of the European War of 1914 all such members shall cease to be members of the Institution on and after the 16th day of March, 1916."

Mr. C. A. Baker, in seconding, said many members thought there had been too much hesitation in bringing the matter to this point. At first the Council had said that it could do nothing except under Article 41. Following that, a petition signed by 17 members was drawn up (this being 7 more than the requisite 10 required by the Articles of Association) with a view to an alteration in the Articles being made. That petition was handed in on January 18th, and a meeting took place between the petitioners and the Council on January 21st. At the meeting three or four alternatives were put forward, and eventually the present proposal was made, on the lines of an alteration already carried out by the Iron & Steel Institute, and it was accepted. The petition did not deal with naturalised aliens, because it was felt that the naturalised alien had a status in the country; he was amenable to the laws of the land, and was get-at-able. There were also naturalised aliens whose sons were fighting for this country. But reading the resolution before the meeting, it appeared to him that naturalised aliens would be excluded—he hoped he was correct—if they had not de-nationalised themselves in their own country.

The President : I will deal with that point.

Mr. Baker, continuing, said it might be asked : "Why turn them out at all ?" It was said that naturalised people do not hurt us, but he thought it was our duty to clear them out from the Institutions from top to bottom. "Have none of them; we do not want them," he added. A substantial reason for that was that practically every British member had sons, brothers, or relatives who had either been killed or wounded in the war. As patriots, we had a birthright to exclude enemy aliens. No man had the right to be in the Institution unless he were a patriot or a friendly alien. It had been suggested there might be some difficulty for the executive officers of the Institution in carrying out rules of this kind, but all executive officers had to use their discretion and their intelligence. An alternative petition was started under Article 41 to exclude specified individuals, but it was felt that this was not a case where individuals should deal with other individuals. It had also been said that people would be afraid to vote. He could not understand such a view, and hoped that all members would vote without fear and without favour.

Mr. A. Gay (Borough Electrical Engineer, Islington) said he had sent a letter to the Secretary asking whether the recognised rules of debate were to be observed, and suggesting certain amendments. This letter was read by the President as follows:

"At the special meeting of the Institution on March 1st I propose to put the following questions to the Chairman at the commencement of the meeting: (1) Will the recognised rules of debate be observed during the meeting? (2) Will the Chairman adopt the rule of allowing voting by ballot only during the meeting?—in the event of his not being in favour of the ballot, will he put it to the meeting to decide, or allow me to do so?

"After the motion on the agenda has been formally moved and seconded, I propose to move the following amendment: To insert after the word 'state' in the fourth line of the printed resolution the words 'or shall be of enemy origin, although a naturalised subject of the British Empire.' If the Chairman refuses to put this amendment, or if it is put, and lost, a further amendment will be moved by another member, as follows: That a vote be taken, by ballot, of the whole of the British-born members of the Institution, by post, both upon the principal motion, and also upon the amendment."

The President, continuing, said that the recognised rules of debate would be observed. It was not proposed to take a postal vote, and he was advised by the Honorary Solicitor (who sat at the Council table) that the amendments put forward by Mr. Gay were out of order. No other business than that given in the notice of the meeting could be transacted. The amendments proposed were a substantial alteration in the business set out on the notices, and to pass them would be *ultra vires*, and could be restrained by injunction in the Courts.

Mr. Gay, who was fully supported by the meeting, said he most strongly protested against this ruling, which was, he said, against all the recognised rules of debate. The amendment was relative to the motion, and was a right and proper one.

The President said the Honorary Solicitor advised that it would be necessary for Mr. Gay to proceed under Article 80, *i.e.*, call a special general meeting to consider the proposed amendments, and unless that was done, he must rule him out of order.

Mr. Gay again protested, with the full sympathy of the meeting. The recognised rules of debate, he said, accepted in the House of Commons and the Borough Councils, allowed amendments to a motion to be discussed, but he bowed to the President's ruling under protest, without withdrawing his amendments.

The President said he was informed by the Honorary Solicitor that the amendments were out of order.

Mr. Gay retorted that everyone made mistakes. He had known solicitors, barristers, and judges make mistakes. If they did not, there would be no need for a Court of Appeal and the House of Lords.

Mr. L. Joseph pointed out that the results of the proposed alteration were not quite clear. Could a member turned out now be re-elected after the war? He thought the idea was that such members should not only be turned out during the war, but should be exiled permanently from the Institution.

Mr. A. H. Walton (British Thomson-Houston Co.), speaking with regard to naturalised aliens who had not been de-nationalised, said there were many good friends of the Institution in that position, and it would be a great injustice to expel them. They all knew several who were as true patriots as British-born men.

Mr. Gay, on a point of order, protested that Mr. Walton was speaking outside the motion, which did not deal with naturalised aliens.

The President, however, allowed Mr. Walton to proceed, but Mr. Gay again energetically protested on the ground that an amendment of his dealing with naturalised aliens had been ruled out of order.

The President requested Mr. Walton to continue.

Mr. Gay again interrupted, but his objection was not upheld by the President.

Mr. Walton said it must not be forgotten that we had allowed these members to come in, and to turn them out now would be very hard upon those whom they knew were perfectly straight and upright.

Mr. C. C. Aitchison (Borough Electrical Engineer, Rochdale, and a Member of the Committee of the Manchester Section of the Institution) remarked that the Council had put this motion forward and apparently expected it to be swallowed wholesale. If they were to take what the Council offered, then the meeting was nothing else than a farce. Furthermore, the meeting was supposed to represent the ideas and opinions of the whole body of members of the Institution, yet it was convened in London.

He had brought this matter before the Manchester Committee in October, but it hung over until December, and then by ten votes to two a certain recommendation was sent to the Council in London. At that Manchester meeting he pointed out that whatever was done by the Council in this matter, the result must be representative of the wishes of the majority of the members, and it was only fair that every member should have an opportunity of giving his vote. It was impossible for all the country members to come to London. When Mr. Sparks was in Manchester, he had stated that he had no communication from the members as to what they desired, but in his (the speaker's) opinion it was not for the members to make suggestions to the Council, but for the Council to find out what the members' views were before it came with its resolution. He was very much in favour of it in many ways, but he regretted that it did not go far enough. (Loud applause.) It did not say what would be the position of alien members at the end of the war. Were they to be allowed to come back to their happy hunting ground and sit at Institution meetings shoulder to shoulder with men who had had to put up with the Germans' ghastly habits at the front? Were Germans to sit alongside members whose families had had sons or relatives killed or wounded, and, maybe, killed in such raids as that of Scarborough? If the position under the resolution was that these men could come back, then that position must be faced.

The President, intervening, said that as far as he could speak as a member, he was not going to have them back again. He might be one alone. (Sir John Snell: No! No!) None of these men were coming back unless the members themselves re-elected them.

Mr. Aitchison replied that all applications for membership were only voted on by members in London. This procedure did not give the whole body of members an opportunity of saying whether they would or would not have alien members re-elected. The fact that names were now first submitted to the Local Councils was the result of action which he himself had taken at Manchester because he had foreseen that if this resolution was passed it would mean that London only would have anything to say on the matter. In any event the Local Committees could only do their best to represent the local inerests, and it was only fair that with a problem of this sort every member should have the opportunity of saying whether they would or would not have enemy members back again. A large number of members would resign from the Institution if the Germans were allowed back. There could be only two reasons why the Council had not said definitely that no German, naturalised or un-naturalised, should come in. First, it had been said that after the war, when the Germans came back to England, they would make it very hot for those who had tried to get them out of the Institution. He was prepared to take the racket for himself, and he hoped others were also. The second reason was that the Council as a body were pro-German.

This latter suggestion was met with a chorus of No! No! from the Council table.

Mr. Gay said he wished to propose another amendment: "That this meeting be adjourned and a vote be taken by ballot of all the corporate members of the Institution by post both upon the principal motion and upon the amendment." If the President refused to accept the latter few words, then he suggested the amendment should stop at the words "principal motion."

The President said he could not deal with this. It would be necessary to give notice in accordance with the Articles of Association.

Mr. Gay said he would therefore move the adjournment of the meeting.

The President said he was going to put the resolution, and if it were rejected, the adjournment of the meeting would follow as a matter of course.

Mr. Gay reminded the President that an amendment must always be considered before the original motion.

The President said he was not accepting the amendment.

Mr. Gay, who still had the meeting strongly with him, said he protested that the whole of the proceedings were entirely irregular.

Mr. F. C. Raphael (Editor of Electrical Engineering) said that it was evident that Mr. Gay's views received the support of the majority of those present, but Mr. Gay would himself recognise that it would be useless to press his amendment and have it passed at that meeting if this procedure was contrary to the Articles of Association and the amendment therefore ineffective. The President had stated that the Council's resolution must be put, and no other, and, although many members wished to extend it, everybody agreed with the resolution as far as it went. It would be a pity, therefore, if it were not passed with absolute unanimity. Consequently he suggested that a simple way out of the difficulty would be for Mr. Gay and Mr. Aitchison to secure the necessary ten signatures (which could be done forthwith) calling for another special general meeting under Article 80 to pass additional alterations to the Articles. This meeting might take place before the confirmatory meeting, which could be postponed to enable the Council's resolution and these further ones to be confirmed together. Perhaps the Council might in the meantime also decide whether they had the power to take a postal vote, and whether it would be expedient to do so.

The President thanked Mr. Raphael for his suggestion, and said that the Hon. Solicitor agreed that that course would be in order. The only point about it was that it was necessary to submit any alteration of the Articles of Association to the Board of Trade before they were made. The resolution now before the meeting had been so submitted.

Mr. Gay said it seemed a most extraordinary method of procedure to submit to the Board of Trade an alteration which had not been discussed or agreed to by the members. He thought Mr. Raphael's suggestion would clear the ground considerably, provided the confirmatory meeting of the present meeting, called for March 16th, was not held before the special general meeting proposed by Mr. Raphael.

The President said that the confirmatory meeting on March 16th must be held, but, if necessary, he would adjourn it in order to allow the special general meeting suggested to be held.

Mr. Gay said in that event he took it the whole of the resolutions, whatever they were, would come forward as substantive motions at one and the same meeting.

The President said that if the resolution before the present meeting was passed, and he received proper notice with regard to the further resolutions which members desired to discuss, he would undertake to adjourn the confirmatory meeting on March 16th if necessary to enable these other resolutions to be discussed.

Mr. Arthur Berkeley (Berkeley & Young) said he did not understand that they had come to the meeting merely to say "yes" or "no" to the resolution, but that there would be an opportunity of thoroughly thrashing out and discussing this question. It seemed, however, to be hedged round with legal technicalities. He would much prefer to sweep all these things away and to realise that this is war-time and not peace. What was wanted was to clean up the Institution. (Loud applause.) For this purpose he would suggest that they should adopt the more "sporting" course of taking some risk, and ignore legal technicalities and discuss the whole question on its merits. He hoped the meeting would do this even if it sat until 10 o'clock to do it.

Mr. Aitchison complained that many members had come from the provinces to settle this matter and now apparently they were to be compelled to come to London three times for the purpose.

The President pointed out that the Articles of Association compelled him to take the course he had, and it must be realised that the Institution was amenable to the law.

Mr. W. B. Woodhouse (Yorkshire Electric Power Co.) said he would vote for the resolution on the understanding that any naturalised alien enemy who had not taken the trouble to get rid of his nationality in the enemy country was automatically cut out by this resolution. At the same time we must look forward to the different conditions after the war (Cries of No! No!), and if the members went as far as to prevent any possibility of reconsidering an application from an alien enemy for membership they might get into trouble. At the same time he was in favour of striking out these people as long as they owed any allegiance to an enemy country. After all, these men could not get back into the Institution unless re-elected by the members, but there was to be no doubt now as to the men who had two nationalities.

Mr. McGregor Duncan said probably when the history of the Institution during the war came to be considered in the future, the members would feel they owed a slight debt of gratitude to those members who had the pluck to come and oppose this resolution. He did so at the risk of being called pro-German. Was the status of the Institution, either as an engineering body or in society, sufficiently high for it to lead in a matter of this importance? The London Stock Exchange, always noted for its extreme patriotism, and consisting largely of sportsmen, had merely gone to the extent of requesting enemy members to refrain from attending during the war. A very similar action had been taken by the Institutions of Civil and Mechanical Engineers (A Voice: More shame for them.), and he suggested that the Institution of Electrical Engineers should follow that course. (Cries of No! No!) If the resolution dealt with Germans only he would not object to it to the extent he did. At the same time it did not seem to him that the members were quite honest; they apparently meant Germans all the time they were speaking of alien members. Perhaps it would be more honest to refer in the resolution to Germans.

The President said he would sum up the discussion. With regard to the position of naturalised members, if a man was naturalised in this country, our laws prevailed over the laws of other countries. At the same time he understood that such a man would not be automatically struck off under the resolution if he had not been de-nationalised in his own country. Nevertheless the Articles of Association provided that any ten members could have such a person struck off if he were thought undesirable. Such cases could be dealt with individually or collectively, but they would not be got rid of automatically if the resolution before the meeting was carried. It had been suggested that London alone dealt with this matter, but quite recently the local sections had been brought into closer touch, and a proposal from Manchester had been adopted in which the local section now acted as one of the three referees to

scrutinise nomination papers, so that if a German or anyone else from Manchester sought admission, Manchester would be asked with regard to him, and to say whether he was undesirable, and the name would not be put forward to the Council if Manchester objected. Even if the Council put forward the name it was still open to the members to object.

Mr. AITCHISON reminded the President that such opposition could then only come from the members in London.

The PRESIDENT agreed, but thought the local section was in a very powerful position, because if it objected and the Council still put forward a name it was the duty of the local section to see that there was trouble.

Mr. L. JOSEPH at this point handed up an amendment to the President.

The PRESIDENT said he could not accept it, but would agree to it being put forward at the special meeting already agreed upon to discuss Mr. Gay's and other amendments.

Mr. A. A. CAMPBELL SWINTON said he was one of the seventeen members who signed the petition referred to by Mr. Baker, but was afraid that the interpretation just put upon the resolution by the President, namely, that it would not exclude those Germans who still retained their German nationality, notwithstanding that they were naturalised Englishmen, was not satisfactory to him, and he could not vote for the resolution.

Mr. W. B. WOODHOUSE (who, it may be noted, is a Member of Council) also said that he had not put the interpretation upon the resolution which the President had as regards de-nationalised Germans, and would be compelled to vote against the resolution.

Mr. E. J. FOX (Stewarts & Lloyd), suggested that the President had not correctly interpreted the meaning of the resolution. It stated that members who were "subjects of such enemy country or State" should cease to be members. If an alien was not de-nationalised he was surely still "a subject of such enemy country or State."

The HON. SOLICITOR said the point was that if an individual had been naturalised, we in this country looked upon him as an Englishman, and did not care how Germans regarded him.

Mr. FOX said he believed the point had been settled in that way in our Law Courts, but this resolution concerned the Articles of Association of the Institution, and it was evident that if a man had not been de-nationalised he was still a subject of such enemy country or State." Apparently it was the intention of the resolution not to deal with those naturalised Englishmen who had not been de-nationalised, and this was entirely contradictory to what the members had been led to believe was the intention.

Mr. G. W. PARTRIDGE (London Electric Supply Corpn.), who is also a Member of the Council, said he wished to express more or less the same views. So long as an alien enemy was a subject of Germany, whether naturalised or not, he should certainly come under this clause.

Mr. A. A. CAMPBELL SWINTON agreed that a naturalised German who had not been de-nationalised would be dealt with as an Englishman in this country and as a German in Germany. From this point of view the President's explanation was correct, namely, that the resolution would not cut out such a man, but this was not what the seventeen signatories to the petition had intended.

The PRESIDENT replied that he could only say that all these rulings had been made upon the advice of the Hon. Solicitor.

Mr. LL. B. ATKINSON (W. T. Glover & Co.), after obtaining the President's permission to submit an amendment to the wording of the resolution, suggested that instead of saying "during such war shall be a subject of such an enemy country or State," the resolution should read: "who at any time during such war has not divested himself of his nationality of such enemy country or State."

The PRESIDENT, after consultation with the Hon. Solicitor, said he was advised that the amendment could not be accepted, a ruling which was received with considerable laughter.

Mr. W. R. COOPER suggested that the resolution might be passed and the meeting adjourned in order to discuss amendments to it, and, if necessary, make such amendments.

The PRESIDENT said in that event it would be necessary to begin all over again.

Mr. COOPER said he thought that would be the best course.

Mr. CAMPBELL SWINTON said he would be bound to vote against the resolution.

Mr. J. H. RIDER also said that after the President's explanation he would have to vote against the resolution, and hoped that all members present would do so. Then a proper resolution could be brought up which everyone understood.

Mr. L. L. ROBINSON (Electrical Engineer, Hackney Borough Council) said it seemed quite clear that there was no resolution before the meeting that could be voted upon in anything like the unanimous manner a resolution on this subject should be. He would like to know if he would be in order in moving that the resolution be referred back to the Council for further consideration, and whether, if that were done, the Council would then bring up a resolution in a form in which it could be discussed, and, if necessary, amended by the members, because, so far as he could see, the present method of procedure was by no means a flexible one, and made it almost impossible to form a resolution to which everyone could agree.

The PRESIDENT said that the only way in which there could be an informal discussion was to call a special general meeting to discuss the matter in all its bearings. If there was a majority present in favour of that course, it could be done after the resolution had been passed, and the confirmatory meeting of the present meeting held later. That would give every member an opportunity of stating his views.

Mr. L. L. ROBINSON proposed that the resolution be referred back.

Mr. GAY seconded.

Mr. F. C. RAPHAEL questioned the correctness of the President's view that the meeting could not be adjourned without the Council's resolution being put to the vote. He reminded the Council that, on the occasion of a previous Extraordinary General Meeting of a similar nature only a few years ago, there had been strong opposition to the Council's original proposals. He had then been in the difficult position of leading that opposition, and so many members had come to support him that it became evident that the Council would have been outvoted. The Council then adopted a very sensible course. They adjourned the meeting (loud laughter), held a subsequent informal meeting as was now proposed, and finally modified their proposals so that they were accepted and passed. The occasion had been the last revision of the Articles of Association, and if the proceedings then were irregular, the existing Articles of Association under which the present meeting was held must be invalid.

Mr. ROBINSON persisted in his motion to refer back the resolution and protested against being asked to discuss a motion with his hands tied.

Mr. BERKELEY said it seemed to him that all those present were at one on this matter, but, owing to an unfortunate misunderstanding, there was a danger of the resolution being put to the meeting and rejected. If that were done, it would undoubtedly do harm outside the Institution.

The PRESIDENT, after consultation with the Hon. Solicitor, said he had decided not to put the resolution, and said he would call another meeting to discuss the whole question. Meanwhile, the Council would be glad to receive suggestions from the members.

This announcement was received with loud applause, and the meeting adjourned.

AN IMAGINARY CONVERSATION, NOT OVERHEARD IN BERLIN

HANS: Well, Fritz. We shall be from the Institution of Electrical Engineers out-chucked.

FRITZ: It is to me quite sausage.

HANS: How so, Fritz?

FRITZ: Never have I a member of their d——d and sewn-up-again Institution been. So do I not my money waste. Beginnings, engage I an Englishman my wares to sell, and offer him 50 per cent. commission. It is custom in England to decry everything English, and my man goes to the meetings of the Institution where the professors are who think everything German good, for in Germany is scientific research encouraged. My by me with-fifty-per-cent.-commission-bought Englishman explains how bad are the English manufactures, and is applauded. Then goes he the next week to the customers and explains that my wares do not these faults possess. Quickly does he a big business establish. A year, perhaps two, wait I, until he has from English manufacturers the business away-taken. Then do I perhaps for a quarter-year with punctual deliveries fail, or establish competition with him, or reduce his commission to 5 per cent., or otherways make him almost Kaput. We in Germany understand these things. Then can I the big-become business acquire or control, and little costs it.

HANS: Sheeps-heads are they, these English!

FRITZ: They "play the game," as they express it, but understand can they not that German business methods are not "cricket."

HANS: But after the war?

FRITZ: After the war shall our agents, beginnings, look unhappy, and will the English not hit a man when he is down. So will it be once more as before the war.

HANS: And will the Institution of Electrical Engineers do nothing?

FRITZ: The Institution will not concern itself with commercial things. The Institution will, as now, be to me quite sausage.

Alien Enemy Firms.—The Associated Municipal Electrical Engineers of Greater London recently passed a resolution calling upon the Government to instruct the Board of Trade to publish in the form of a Blue Book, or otherwise, a list of alien enemy firms now operating in Great Britain. The Southwark Borough Council last week had this resolution before them and concurred in it.

The Institution.—A discussion will take place at the meeting of the Institution of Electrical Engineers on April 13th on "The present position of Electricity Supply in the United Kingdom; and the steps to be taken to improve and strengthen it after the War."

"LINKING UP" IN SWITZERLAND

Important Co-operation of the Swiss Power Undertakings, for Interchange and Utilisation of Excess Energy

An intensely interesting and highly important movement is now well under way in Switzerland for the better co-operation of the numerous power undertakings, particularly with a view to utilising the spare energy. Practically all the large generating stations are, of course, water-power stations, and for those without storage reservoirs this question of the utilisation of the spare energy is extremely important, as the water not actually passed through the turbines has to be allowed to flow over the spillway and be wasted. This occurs every night, on Sundays, and for an hour or so during the middle of each day; but the chief waste occurs during the summer months, when the flow of water is always much more than that required. Generally, of course, this excess summer flow is more than that corresponding to the maximum capacity of the installed turbines, but the cost of additional plant to utilise this excess flow would be very small compared with the original cost per h.p. of the whole development.

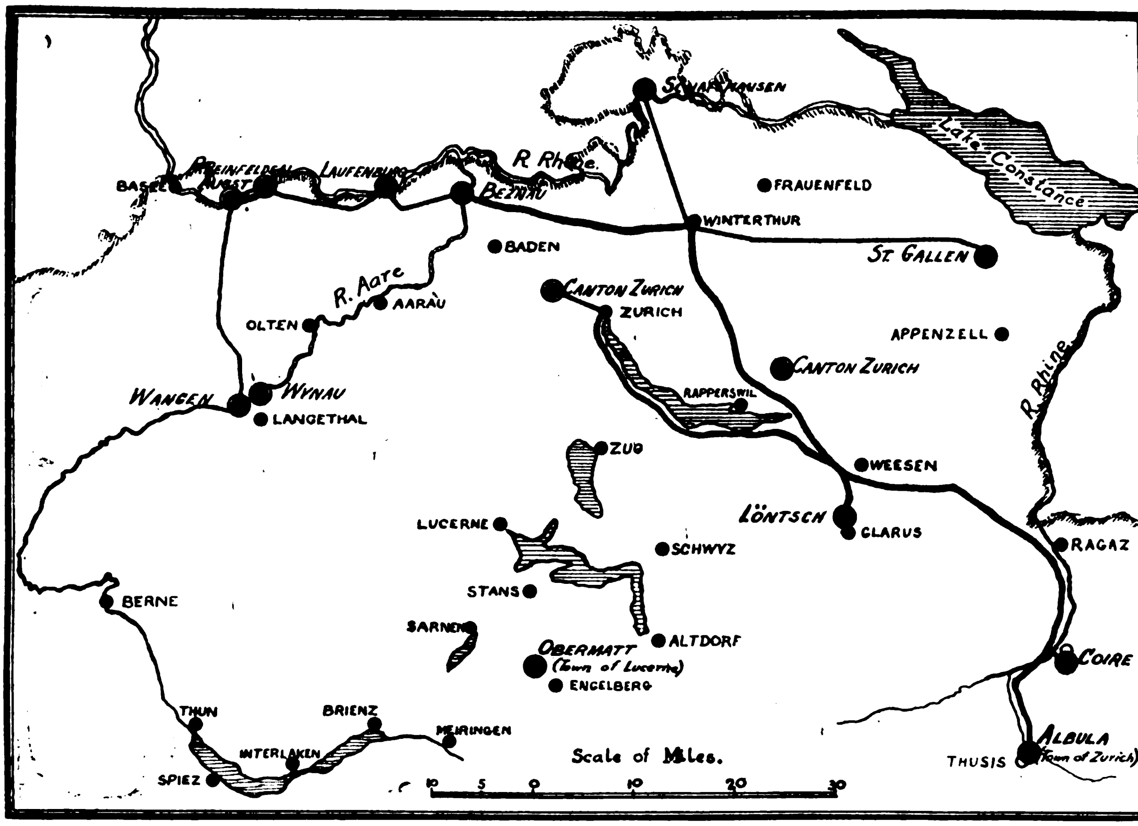
Realising the great possibilities of this idea, the Schweizerische Wasserwirtschafts Verband, a society founded for the purpose of encouraging the development of the Swiss water powers, succeeded in calling together in Zurich, on July 9th, 1915, the representatives of the twelve power undertakings of North-east Switzerland, which distribute on the three-phase system with the common frequency of 50 cycles. The idea was generally approved, and a Commission was appointed to study the technical and commercial possibilities of the scheme.

land might be as much as 20 to 30 million units. Again, it was always several years before any new plant was com-

Three-phase 50 cycle Water Power Central Stations in N.E. Switzerland.

Works.	Owner.	Installed H.P.	Fall metres.	Useful Storage (cubic metres).
Augst-Wylen	Town of Basle	30,000	4·8—8·4	nil
Rheinfelden	The Power Transmission Works	18,800	3·3—5·2	"
Wynau	Wynau Electricity Works................	4,750	2·5—4	"
Waldhalde ...	Canton of Zurich......	2,250	—	—
Albula.........	Town of Zurich	24,000	140·4	420,000
Coire	Town of Coire	680	91	—
Obermatt ...	Town of Lucerne	8,600	313—315	70,000
St. Gallen ...	Canton of St. Gallen	9,400	83—92	1,466,000
Wangen Aare	Wangen Electricity Works................	10,500	7·7—8·9	nil
Loentsch ...	North-East Power Works Co.		341·7	45,000,000
Beznau	North-East Power Works Co.	51,000 14,400	3·1—5·8	nil
Laufenburg	Laufenburg Power Works Co.	50,000	8—9	—
Schaffhausen	Town of Schaffhausen	4,000	155—160	70,000
	Total.........	228,380	—	—

pletely loaded up, and the energy allowed to go to waste in the meantime was very considerable. As an example, the



The twelve power undertakings in question are given in the following table, and also shown on the map above. These have all expressed themselves in accord with the idea. All except two—namely, the Wynau and Lucerne works—are already connected electrically, but, with some exceptions, only for the purpose of emergency supply.

The need and possibilities of the suggested co-operation were clearly stated in the report presented at the above meeting by Herr A. Härry, the Secretary of the Verband. Besides the excess power referred to above, there were always, he stated, considerable fluctuations in the demand for industrial power. For example, as a result of the war, the output of the four works at Augst, Baden, St. Gallen, and Wynau for the year 1914-15 was 7·7 million units less than during the previous year, and the reduction for the whole of Switzer-

Laufenburg works could be mentioned, with a possible output of 150 to 200 million units per annum. If the available output of these special cases were added to the other sources of spare energy referred to above, it would be found that a huge amount of energy was available for sale or utilisation—the greater portion, however, only for limited periods. The problem was to find a suitable consumer, and the most likely were to be found in the electrochemical and electrometallurgical industries. Some branches of these industries were not bound to work at any particular time or for any definite periods, but all had the disadvantage that the commercial success of the process was dependent upon the energy being obtained at the very low rate of from 0·5 to 1·0 centime (approximately 0·05d. to 0·1d.) per unit.

Some power undertakings had already tackled the problem

by co-operating singly with adjacent electrochemical works. Thus the Chèvres works of the town of Geneva supplied some of its excess energy to the Lonza A.G. for the manufacture of carbide and sodium, while the Thusy, Schaffhausen, and Aarau works supplied power during limited hours to a large electric steel-furnace installation. Again, limited hour supply for carbide manufacture was given by the Montbovon, Kallnach, Aarau, Beznau, and Albula works, and the Rheinfelden works had reserved half its generating plant for the manufacture of aluminium and carbide at Neuhausen. The last-named also participated in the supply of power to the Griesheim-Elektron works for the manufacture of chlorates and carbide, and to another factory for the manufacture of sodium.

These individual efforts were not the best solution, however, as the supply was naturally given under some form of contract, and consequently the generating stations might at times have to supply energy to the electrochemical works which they could sell on better terms for other purpose. Co-operation of the different power undertakings in this respect would not only obviate this contingency, but would make a very much larger quantity of spare energy available at any one centre, and, owing to the diversity of loads and of available water over the year, would to some extent smooth out the intermittent nature of the available power supply. The electrical connection of the different undertakings would, moreover, make for continuity of local supply and enable an interchange of power to cover unexpected demands and plant breakdowns.

The power undertakings of Switzerland could be divided into three or four groups for the above purpose. Owing to the common system and frequency, and the fact that many of the stations were already electrically connected, the North-east group was simplest to consider. Herr Härry estimated that, for the year 1913, the possible output of the twelve stations mentioned, excluding the Rheinfelden and Schaffhausen works, was 530 million units, whereas the actual output was only 324 millions, or approximately 62 per cent. Assuming that 75 per cent. of the spare 200 million units were sold for electrochemical purposes at a price of only 0·5 centime (0·05d.) per unit, the revenue from the sale would be 750,000 francs (£30,000), while the extra expenditure would be practically nil. The above assumed that a large portion of the spare energy in the short midday period as well as during the nights and in the summer would be sold, and this was quite possible. The Chèvres works of the town of Geneva already sold energy for such short periods for the electrolytic manufacture of sodium and hydrogen. Further, there were already some cases in which a supply was given on the condition that it could be discontinued during any period as required by the suppliers. The Sills works at Innsbruck, for example, supplied up to 15,000 kw. to a nitrate factory. The factory was obliged to take up 9,000 kw. continuously over the twenty-four hours, but could not demand it continuously, having to take only what the suppliers could spare. To avoid heavy fluctuation of the power demand, the factory was further obliged to dissipate in water resistances what it could not use of the kw. demand fixed for any given period.

An example in Switzerland of the kind of co-operation suggested was the agreement between the city of Zurich (Albula works) and the North-East Power Works (Beznau & Loentsch works) for the supply of power to the Thusis carbide factory. The nearest power-station to the factory was the Albula works, as shown on the accompanying map. Actually, the latter supplied the whole factory demand, leaving the Beznau and Loentsch works to make up what it could not take on of the Zurich load. The combination has a further interest, as the Beznau and Loentsch stations are themselves complementary, in that the former is a low-head works with a fairly constant flow, and the latter a high-head development with an enormous storage to help over the daily and winter peaks. The route of the transmission lines connecting the three stations is shown on the map.

The Verband had already approached representatives of the electrochemical industry, and with encouraging results. The Lonza A.G., for example, the largest electrochemical undertaking in Switzerland, considered that the suggested co-operation of the power undertakings for this purpose was necessarily the first step to be taken, as electrochemical works were only commercially successful when on a large scale demanding a very large supply of energy at a low price; and these conditions could only be attained by a group of stations co-operating in this way.

It had been suggested, continued Mr. Härry, that the power undertakings co-operating should establish one or more electrochemical factories themselves, but there were serious commercial difficulties in the way of such a solution. Not only would they have the competition of the established electrochemical undertakings to reckon with, but they must remember that most of the electrochemical processes were patented and worked exclusively by the owners of the patents. For example, the Haber process for the manufacture of nitric acid and nitrates was owned by the Badische Anilin & Sodafabrik of Ludwigshafen, and it was not probable that they could obtain a licence to work it. They might, however, arrange for licences to work the Birkeland-Eyde or Schönfeld processes. The industry best suited for the conditions of spare power supply would be the electrolytic manufacture of hydrogen, &c.

In view of these difficulties, concluded Herr Härry, the Verband considered it more practicable for the power undertakings to come to an arrangement with one or more of the existing large electrochemical undertakings, such as the A.G. Lonza, manufacturing carbide, ferro-silicon, and other products, or the Rheinsalinen A.G., which manufactures chlorate and sodium. The former company had already expressed itself in sympathy with such an arrangement, and offered to take part in the preliminary investigations.

The Commission formed at the above meeting has already commenced its investigations, and is to be enlarged by representation from the Swiss Association of Electricity Works and the Swiss Electrical Association, so that the investigation will be extended to include all the power undertakings of Switzerland. The criticisms of the scheme which have been made refer mainly to the difficulty of finding a consumer for the midday "lunch-hour" power, but this is a very small proportion of the available energy. It has also been suggested that the spare energy during the nights should not be sold too cheap, as there are hopes that a system of heat storage will soon be developed, enabling this night energy to be used for the heating and cooking of the day. The cost of the interconnecting transmission lines and transformers and the increased risk of surges and other disturbances of the system due to the linking-up have also been brought up as difficulties in the way. Generally, however, the idea is considered practicable and commercially promising, and particular stress is laid on the advantages which will come from the possibility of the interchange of energy between works of diverse characteristics as regards available water supply.

War Tribunals.—At Loughborough last week, according to the *Leicester Post*, exemption was applied for by the manager of a company manufacturing electrical heating and cooking apparatus who produced evidence that he was recognised as one of the few experts in this growing and important British industry. The applicant stated that his mother and sister relied upon his support, and he also produced a medical certificate relating to himself. He was granted exemption conditionally on the circumstances continuing.—The son of a Liverpool electrical contractor has been given exemption for two months last week in order to enable him to complete certain large contracts which he is carrying out on behalf of his father.—At Dorking, Edmundson's Electricity Corporation applied for exemption for their chief accountant there on the ground that he was essential to the business. The Chairman of the tribunal, however, suggested that a lady could do the work, and eventually the applicant was put back two months.—Two applicants at Chesterfield were employed at the Corporation Electricity Works, and both appealed for exemption for conscientious reasons, one stating that he is a member of the Christadelphian Church. The Christadelphian was named for non-combatant service, and the claim for exemption in the other case was refused. An electrical fitter at Southport, also a conscientious objector, was named for non-combatant service.

British Trade with Spain.—The British Chamber of Commerce for Spain writes us that, in view of the powerful and unscrupulous Press campaign which is being carried on in that country in pro-German interests, a combined effort to counteract it should be made at once. The Chamber is of the opinion that a well-organised advertising campaign on behalf of British productions would certainly meet with immediate success, especially if applied to household articles of daily use. Advertisements should be inserted only in those papers free from German influence. The Chamber is compiling a list of the most influential in Madrid, Barcelona, Seville, Bilbao, and other centres, and, having the placing of a large number of advertisements itself, may be able to obtain specially advantageous rates, rebates, and discounts, the benefit of which will be given to advertisers or their agents. The Chamber will, if desired, undertake the translation of advertisements into Spanish free of charge. Firms which prefer to leave their advertising to local agents should instruct them to patronise only those newspapers recommended by the British Chamber of Commerce. Applications should be addressed to the Secretary, Advertisement Committee, British Chamber of Commerce for Spain, Plaza Cataluña 9, Barcelona.

THE "EYE-REST" SYSTEM AT ARMSTRONG-WHITWORTH'S

A TYPICAL example of a lighting installation carried out on scientific principles is afforded by that at the new offices of Sir W. G. Armstrong, Whitworth & Co., Ltd., Walker Shipyard, Wallsend-on-Tyne. No fewer than 450 lighting points are comprised in the scheme, which is, we believe, the first office installation on a large scale in the Newcastle district is to be equipped throughout with the British Thomson-Houston Co.'s "Eye-Rest" and semi-indirect fittings. Since every department throughout the extensive premises has been lighted with due regard for the purpose it serves, the treatment shows a wide difference as regards the class of fittings employed and the type and candle-power of the lamps used, and the accompanying illustrations, selected from a number of photographs placed at our disposal by the B.T.-H. Co., are merely representative of the results secured.

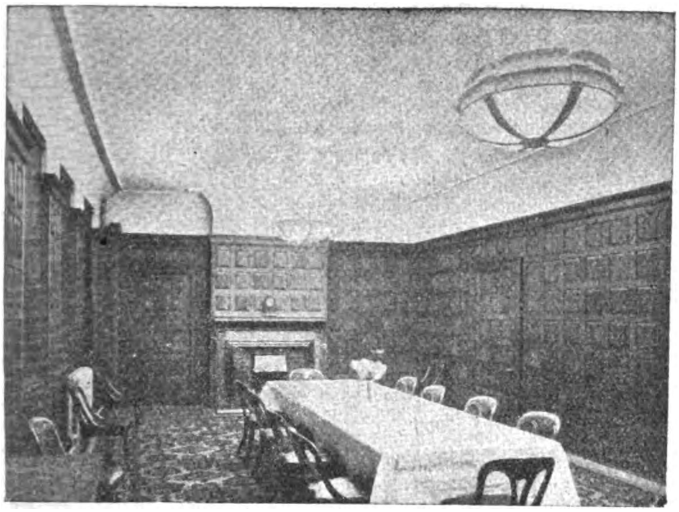


Fig. 1.—Oak Panel Dining-room.

The whole of the electrical lighting equipment was supplied by the above-named Company through the Newcastle-upon-Tyne Electric Supply Co., Ltd., the wiring work being carried out by R. W. Cairns as sub-contractor to the Newcastle Co.

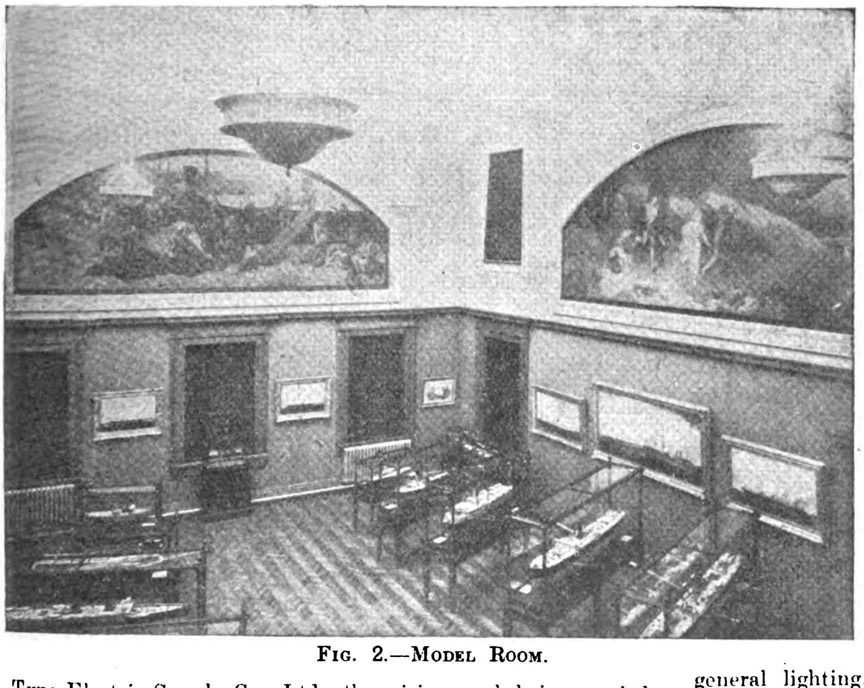


Fig. 2.—Model Room.

In the drawing office, which measures 54 ft. by 34 ft., are installed 22 B.T.-H. "Lumina" semi-indirect fittings of the pendent type, arranged to afford evenly-distributed illumination on the working plane. Similar fittings, but of the close-ceiling type, are employed in the tracing and general offices, the former containing 200-watt and the latter 300-watt Mazda half-watt lamps. The tracing office lighting was intended originally to be effected by standard lamps, but with the introduction of low candle power half-watts, the latest development in lamp manufacture was adopted. The lighting on the flat boards is particularly good, the average foot-candles obtained exceeding materially those provided for in the specification.

In the directors' office, and one of the dining-rooms (which we illustrate), "Luminous-Bowl Eye-rest" fittings are made use of. The lower portion of the "Eye-Rest" bowl is of white or coloured glass, but there is no alteration in its internal equipment, except that a lamp of quite small candle-power, enclosed within a diffusing globe, lights up the lower translucent portion of the bowl, and so removes the dark effect of the bowl itself. The directors' office has two pendants on that principle, with 24-in. luminous panelled, composition bowls, each fitted with two 100-watt standard Mazda lamps. The illumination is very uniform, and such details as the pictures and the patterns of the carpet are brought out with remarkable clearness. The dining-room measures 20 ft. 6 in. by 32 ft. 6 in., and is panelled in dark oak. As lighting experts know, the lighting of a panelled room is a by no means easy matter. Excellent results have, however, been secured with two of these luminous bowl fittings, each equipped with six standard 60-watt Mazda lamps.

In passing, it is of interest to note that the whole of the cooking for the officials and staff, as well as for the workmen, is carried out electrically, the installation being one of the largest yet put down in this country.

Corridor lighting is always a difficult problem, and the corridors at the Walker Shipyard offices are arranged on a curve, thus adding to the difficulty. Uniform and adequate lighting has, however, been secured by the adoption of ceiling fittings, carrying small spheres of ribbed "Alabas" glass. equipped with standard Mazda lamps. In the correspondence office there are four plain brass "Eye-Rest" pendants, each with a 200-watt standard Mazda lamp.

We give an illustration of the model room. Here are arranged in glass cases models of warships and other vessels constructed by Armstrong-Whitworth. The room, which is 25 ft. high, measuring 35 ft. by 45 ft., is lighted by four ornamental "Eye-Rest" pendants with composition bowls, each fitting concealing a 500-watt Mazda half-watt. The walls are dark red, a colour notoriously bad for assisting the lighting by reflection, but nevertheless every detail of the models can be easily followed, while the hanging pictures and the mural paintings show up with surprising clearness.

The British Thomson-Houston Co. inform us that the photographs here reproduced were taken by the unaided light of the Mazda units installed, and have not been retouched in any way.

"REFLEX" CARBONS

EIGHT or nine months ago the Electrical Engineering & Equipment Co., Ltd. (109–111 New Oxford Street), offered a prize of £25 to the cinematograph operator who could show the biggest saving over a period of six months by using "Reflex" carbons. The time allowed elapsed on Jan. 31st last, and the prize has been awarded to Mr. C. J. Lord, the operator of the Princess Picture Palace, Rawmarsh, Rotherham (Yorks.).

During the latter half of 1914, with Conradty carbons, the consumption was 2,560 units; during the latter half of 1915, with "Reflex" carbons, 1,890 units only were consumed. The same number of "shows" was run during the two periods, viz., two houses nightly of two hours each, and three matinées weekly. In the latter half of 1915 eighty-five positive carbons, 12 in. by 20 mm., were employed, and 175 negative 6 in. by 14 mm., and a current of 25 to 30 amperes. This, it is stated by Mr. Lord, was about 10 amperes less than previously, and a whiter and steadier light, he says, was obobtained.

It will be noticed that the saving in units metered is less than this saving in current represents, presumably due to the consumption for general lighting. The "Reflex" carbons, supplied by the above-mentioned Company, are of Swiss manufacture.

"Whitaker's Almanack."—For the 48th year "Whitaker's Almanack" makes its appearance, the make-up indicating no radical departure, although the information contained in it is as complete as its reputation leads us to expect. A special section is devoted to "The Great War," and is a brief guide to all that had happened up to the time of the book going to press.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published March 2nd, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

17,851/14. **A.C. Motor.** D. SUCHOSTAWER. A motor consisting of a stator fitted with a system inwardly radiating poles excited from an A.C. circuit and a rotor with similar poles radiating outwardly and carrying a secondary winding. A contact arrangement is provided so that the secondary winding is closed when the rotor and stator poles are opposite one another and a repulsive force is produced, but is open-circuited when the rotor poles have reached a position half-way between the stator poles when an attractive force is produced. (Six figures.)

2,045/15. **Storage Batteries.** J. P. HAWORTH. A positive electrode composed of a body grid from one side of which a series of half-cylindrical grids project so as to form spaces between them and the body grid for the receipt of the active material. (Three figures.)

2,894/15. **Electric Heating.** W. J. READETT. The application of electric heating to tools and dies used for moulding celluloid or similar inflammable or non-conductive substances. (Two figures.)

6,042/15. **Switch Plug.** R. MOORE. A combined rotary switch and plug connection in which the plug becomes locked to the switch casing on rotating the plug to close the switch and unlocked on the opening of the switch pivoted contacts acted on by springs quicken the release. The contacts are always clear of the terminals when the plug connection is turned ready for its disengagement or is removed. (Eight figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Dynamos, Motors, and Transformers: F. KRUPP A.G. [D. C. Generators] 1,405/14; HEYLAND [Polyphase commutator machines] 12,282/14; COMPTON & Co. and PENSABENE [Dynamos] 2,618/15.

Electrometallurgy and Electrochemistry: MARINO [Deposition of metallic coatings on china, glass, &c.], 2,698/15; MELLERSH-JACKSON (*American Smelting and Refining Co.*) [Electrolytic refining of tin], 11,313/15.

Heating and Cooking: WELCH [Convertible electric fire] 2,250/15; BERRY [Heating apparatus] 2,312/15; VAUGHAN [Dental hot-air syringe] 5,351/15.

Ignition: BRITISH WESTINGHOUSE ELECT. & MNF. Co. [Combined ignition and starting machine] 13,985/15.

Switchgear, Fuses and Fittings: COX and SMITH [Switches] 23,107/14; HUMPHREYS, QUINT and FELT [Switches] 2,328/15; BOWEN [Lock switches] 12,892/15.

Telephony and Telegraphy: WESTERN ELECTRIC Co. [Printing Telegraphs] 3,987/15; RELAY AUTOMATIC TELEPHONE Co. and BYGRAVE [Telephone systems] 7,704/15.

Miscellaneous: HAILWOOD [Portable lamps] 416/15; JAMES [Electro-dynamic braking of feed reels] 596/15; MAJOR and SMITH, MAJOR, & STEVENS, LTD. [Lifts] 2,532/15; MARKS (*Interstate Electric Novelty Co.*) [Tubular pocket lamps] 2,696/15; MYER [Magnetic toy] 8,695/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [X-ray tubes] 9,279/15; WILLIS [Organ valves] 12,951/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

(Numbers in brackets relate to the new system of numbering.)

Telephony: NAAMLOOZE VENNOOTSCHAP DE NEDERLANISHE THERMO-TELEPHOON MAATSCHAPPIJ [Thermic telephones] 5,832–5,840/15; F. KRUPP A.G. GRUSONWERK [Magnetic separators] 484, 488 & 489/16 (*100,062, 3 & 4*).

Expired Patents

The following are the more important patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: A. F. BERRY [Switches for cutting out transformers on light load] 25,149/02; H. A. MAVOR and MAVOR & COULSON [Commutator connections] 23,738/05; A. M. TAYLOR [Battery boosters] 24,643/08; B.T.-H. Co. [Commutating poles] 24,854/08.

Switchgear, Fuses, and Fittings: A. S. ADLER [Voltage regulator] 25,012/03; B.T.-H. Co. [Remote control oil switches] 25,026/04.

A NEW MAZDA LAMP CATALOGUE

A NEW 48-page catalogue of incandescent lamps has been issued by the British Thomson-Houston Co., Ltd. It is not merely a price list, but contains data regarding Mazda lamp characteristics and illumination. No fewer than 49 distinct types of Mazda lamps with tungsten filaments are listed. Bearing in mind that most patterns are made for a range of voltages, and in a number of wattage sizes, and can be obtained with two or more alternative styles of caps, it can be understood that the variety that may be made and stocked runs into the tens of thousands. The sizes range from a 1 c.p. lamp for use with a portable battery to the 3,000 c.p. half-watt lamp. Among special forms of Mazda lamps may be mentioned the focussing type with bunched or with grid filaments, lamps for train, motor-'bus, and steamship lighting, and 13 different types of motor-car lamps. A complete range of Mazda half-watts is included, the smallest unit, apart from the automobile type, being of 15 watts for 25-volt circuits; a projector model with grid-shaped filament is offered for photographic and for cinematograph lantern work.

Included in one of the tables at the beginning of the book is a column giving the "lumens per watt" rating of lamps of various sizes. "There is a steadily growing tendency," it is said, "to speak of the 'efficiency' of light sources in terms of 'lumens per watt' rather than in terms of watts per candle. Sources which have similar light distributions may be adequately compared on a basis of watts per mean horizontal candle-power, but this basis when applied to sources having dissimilar distributions affords no real measure of comparison. On the other hand, the lumen is a measure of the quantity of light irrespective of direction, and the term 'lumens per watt' is therefore a true measure of efficiency for all types of electric light sources."

A copy of this useful list can be obtained on special request to Mazda House, 77 Upper Thames Street, London, E.C.

The Institution Roll of Honour.—The journal of the Institution of Electrical Engineers for March gives a second list of members who have lost their lives fighting for their country. We gave the first list in our issue for February 10th, page 48. The second list now given is as follows:—

MEMBER: *Died.*—G. P. Seligmann-Lui, Director, French Military Telegraphs.

ASSOCIATE MEMBERS: *Killed in Action.*—2nd Lieut. H. J. G. Davidson, 1st Lancashire Fusiliers; Sergeant E. Hoyle, H.A.C. *Died of Wounds.*—Sergeant G. S. Bradbury, 6th Manchester Regt.

STUDENTS: *Killed in Action.*—2nd Lieut. J. Forbes, R.E.; Trooper F. E. Hunt, Sussex Yeomanry; Lieut. J. M. Thornton, R.E.

Died of Wounds.—Private C. H. Hill, 16th Canadian Infantry.

The Institution, Western Section.—The following are the nominations to fill vacancies on the Committee of the Western Section of the Institution of Electrical Engineers at the end of the present session which concludes on September 30th: *Chairman*, Dr. David Robertson; *Vice-Chairman*, R. Howard Fletcher; *Committee*, F. S. Carter, W. D'A. Madden, T. Mills, C. G. M. New, C. F. Proctor, H. I. Rogers, A. L. Stephens. Further nominations can be received not later than March 20th.

An Ediswan Showcard.—The Edison & Swan United Electric Light Co. (Ponder's End, Middlesex) is issuing to contractors a striking showcard advertising Edison drawn wire lamps. This measures 18 in. by 13½ in., and bears an arm holding out a cardboard model of the Royal Ediswan lamp from a blue background. The effect of this, together with the multi-coloured printing upon the blue background, is extremely effective.

London Electrical Engineers (T.F.).—Temporary Captain F. H. Masters is promoted to Temporary Major.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

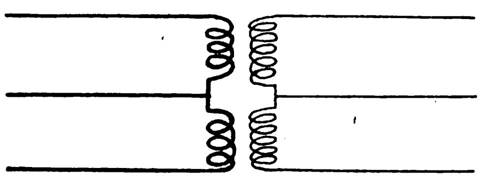
QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,485.

Explain and sketch the curves, &c., of the phenomena that occur which make it possible to take three-phase supply from two single-phase transformers, connected as per sketch.—W. E. L.



(*Replies must be received not later than first post, Thursday, March 16th.*)

ANSWERS TO No. 1,483.

How often should an induction motor be tested for drop in the armature due to wear of bearings? The motor in question is a Century (Chicago, U.S.A.), three-phase, 3-h.p. motor, driving a fan for organ blowing. There are only two bearings to the set, the fan being on a shaft extension outside the bearing. The motor runs on an average eight hours a week.—"KIRK."

The first award (10s.) is made to "W. H." for the following reply:—

It is rather difficult to state any definite periods after which it is advisable to test the bearings of an induction motor for wear.

As, however, it is such a simple matter to measure the air-gap of a motor by means of a set of feelers, the operation may be effected just as frequently as desired. In the case of a small machine such as this, even though supporting a fan rotor on the shaft extension, there should be no appreciable bearing wear for several years when running only eight hours per week.

The normal air-gap of such a motor as this, viz., 3 h.p., would be generally rather less than 0·02 in., say about 0·018 in. Assuming the air-gap to be 0·018 in., there should be no danger of the rotor rubbing on the stator until the bearing wear has made the gap about 0·027 in. on the top, and correspondingly 0·009 in. on the bottom side. This, being measured when stationary, gives an allowance for unequal magnetic pull due to de-centring.

In the case under consideration, owing to the small power absorbed and the infrequent service, it is permissible to allow more bearing wear than usual, as the loss of efficiency due to the unequal air-gap is of small moment.

The bearings should be rebushed, say, when the top air-gap is a little more than twice as long as the bottom air-gap.

A set of feelers sufficient for the purpose of measuring the air-gap could be obtained for 5s. or 7s. 6d.

The second award (5s.) is made to "M. M." for the following:—

It is impossible to say how often such a motor should be tested for eccentricity of rotor in the stator, but provided bearings are kept well lubricated, once a quarter should be sufficient. That is, when the meter readings are usually checked. Some motors that are belt-driven, or have a geared drive, occasionally suffer at their bearings, but the motor in question should have very little side drag. The writer is using a patent grease; a twisted pin passing through the grease rests on the revolving spindle, and the results are excellent. Not only is the arrangement cleanly, as there is not any oil to throw about, but wear at the bearings is a minimum.

For taking the test there is nothing better than a slip of sheet steel, say 3/16 in. in width at one end, tapering to a point at the other. Any small amount of eccentricity is at once apparent from noting how far the wedge may be inserted between rotor and stator. The motor mentioned will have an air-gap of about 1/32 in.; then if slip is 3 in. in length it will enter ½ in.

There is not much trouble to be apprehended should test show a slight eccentricity, but, of course, there must be no danger of rotor touching the stator. For a motor subject to sudden rushes of overload, eccentricity of the rotor may cause it to be pulled against the stator, but under usual conditions there is not much to fear from the rotor being slightly out of centre.

Given ordinary care, induction motors will run for years without showing any appreciable wear at the bearings.

G.E.C. ELECTRICAL PLANT FOR CHINA

THE General Electric Co., Ltd. (of Witton, Birmingham, Manchester, and London), have sent us the following particulars of electrical contracts which have been secured in China recently by their affiliated company, the General Electric Co., of China, Ltd., whose head office is in Shanghai, with a branch office in Hong Kong.

An important contract for the electrical lighting of the ancient city of Ningpo has recently been secured. The negotiations were very protracted, even by the Chinese standard, as they took nearly three years from start to finish. The existing plant is of German manufacture, and was partly second-hand when installed. The new plant will consist of a 120 kw. "Witton" steam-driven, three-phase, high-pressure alternator, complete with main high-pressure switchboard, feeder panels, transformers, &c. The generating station is situated in the Chinese quarter of the city, and, to transmit the electrical energy to the European quarter under the new scheme, a cable is laid in the bed of the river. Previously the Chinese had a very primitive high-pressure cable laid across a pontoon bridge, which was opened from time to time for sailing craft to get through. No proper system of breaking connection was provided, a rough-and-ready method of connection and disconnection only being used.

Another recent contract is for the complete electrical plant for lighting the city of Yangchow, where electric light has not hitherto been used. The first demand is for plant of 160 kw. capacity. As is the case of Ningpo a "Witton" high-pressure alternator, direct-coupled to a Belliss engine fed with steam from B. & W. watertube boilers, is used.

In the south of China a contract was obtained recently for four complete lighting sets for the City of Kweilin. In addition to the above, plant and switchgear have recently been supplied to to the Fatshun Electric Co., the Nanking Electric Co., Funshun City, &c., &c. Several further contracts are now being negotiated. Besides the foregoing, the General Electric Co. of China, Ltd., has just supplied a 125 kw. three-phase "Witton" alternator, ten 10 h.p., one 25 h.p., and several smaller "Witton" motors for a Chinese cotton and rice mill at Yangchow.

The company also informs us that the sales of Osram drawn-wire lamps, as well as electrical supplies generally, are exceedingly brisk in China, and it looks forward to a long period of great prosperity.

Electrical Trade with New Zealand.—Mr. W. G. Wickham, late H.M. Trade Commissioner for New Zealand, states in the *Board of Trade Journal* that the electrical machinery and cables imported into New Zealand in 1914 were almost entirely for lighting, telegraph, and telephone purposes. The value of this machinery imported under the preferential tariff was £147,954 from the United Kingdom, and £236,163 altogether, including other countries. Under the general tariff the total amount imported was £156,005, of which the United Kingdom supplied £123,916. In every line the United States was the chief competitor, with Germany following at a long distance. It is satisfactory to note that two-thirds of the generators, motors, and transformers imported came from the United Kingdom, as did more than half of the lamps and fittings.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Bo'ness.—The Council and the National Electric Construction Co. have now come to terms with regard to the extension scheme which has been referred to in these columns from time to time, and an application is to be made for powers to borrow £14,500.

Dundee.—Twelve months' supply of meters and general electrical stores. City Electrical Engineer. March 29th.

Leigh.—An application is to be made for sanction to borrow £18,300 for electrical extensions.

Wiring

Bradford.—Fittings for branch library. Allerton, City Architect, Town Hall.

Exeter.—The Building Committee have decided to light a portion of the workhouse by electricity.

Heston and Isleworth.—The Joint Isolation Hospital Committee require tenders for electric light fittings and telephone maintenance for the year to March 31st, 1917. Clerk, Hounslow. March 14th.

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. Wiring contractors are recommended to make inquiries to ascertain whether electrical work will be required.

Doncaster.—Cinematograph theatre at Edlington. Architect, D. Milne, 8 Priory Place, Doncaster.

Plymouth.—Extensions to asylum buildings. Blackadon.

Miscellaneous

London: *L.C.C.*—Tenders are invited for supplies of electric lamps for the Asylums & Mental Deficiency Committee. Clerk, 6 Waterloo Place, S.W. March 10th.

APPOINTMENTS AND PERSONAL NOTES

A proposal of the Belfast Tramways & Electricity Committee to appoint Mr. Andrew Nance consulting engineer to the Tramways Department on his relinquishing the post of general manager, as mentioned on page 80 of our last issue, was carried at the meeting of the Corporation after a long debate, in which a good deal of feeling was introduced. Mr. Nance was transferred from the Tramway Company at the time the Corporation took over the undertaking in 1904, one of the conditions being that, on account of his age, he should not be entitled to a pension. The opponents to the proposal to appoint him consulting engineer claim that this is an attempt to get behind the conditions of Mr. Nance's appointment as general manager.

The Blackburn Council has decided to increase the salary of Mr. P. P. Wheelwright, Borough Electrical Engineer, from £700 to £800 per annum. There was some opposition, and on the first vote the advance was refused by 22 to 20 votes. On a division this result was changed to a vote in favour by 25 to 22.

Mr. T. Gladdy, who for the past eight or nine years has had charge of the accessories section of the Supply Department of Messrs. Siemens Bros. Dynamo Works, 39 Upper Thames Street, E.C., is leaving to take up the post of commercial manager with Messrs. Trevelyan & Co., manufacturers of accessories for the electrical and general engineering trades at 155 Bracebridge Street, Birmingham.

Mr. J. B. Feltham, station engineer at the Gloucester Electricity Works, has resigned on securing an appointment elsewhere.

Mr. W. H. Patchell has removed his offices from Caxton House to 64 Victoria Street, Westminster.

The gross value of the late Mr. Thomas Parker's will was £13,380.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £135 to £137 (last week the same).

Fire.—We are informed that the fire which broke out at the works of Nalder Bros. & Thompson, Ltd., Kingsland Green, on Sunday morning last, was fortunately discovered in time, and the damage done, though somewhat inconvenient, has not shut down the works.

Jenson & Nicholson.—Mr. Arthur Hutchings has joined this firm as Manager of their Insulating Varnish Department. His long practical experience in a similar capacity and in the electrical manufacturing business will be an asset to the firm.

Agencies.—A Montreal firm, having branches in many other places in Canada, desires to represent United Kingdom manufacturers of electric lamps.

A local agent at Bordeaux desires to represent British manufacturers of electric lamps. The *Board of Trade Journal* states there is a very great demand, the market having hitherto been inundated with German products.

A Milan agent wishes to represent United Kingdom manufacturers of electrical accessories. Further particulars at 73 Basinghall Street, E.C., in all three cases.

Price Advances.—The Benjamin Electric, Ltd. (1a Rosebery Avenue, London, E.C.), notify further increases in certain of their catalogue prices owing to heavier costs of raw material, particularly metal.

Wood for Electrical Purposes.—In view of the restrictions now placed on the imports of hard woods, the Electrical Supplies Co. ("The Light House," 233 Tottenham Court Road, W.) notify the trade that they hold large stocks of wood blocks for electrical purposes. Delivery can be given from stock, and the prices are normal.

London Electric Supply Co.s' Dividends.—All the London Electric Supply Companies have now issued their accounts or dividend announcements for 1915. We have already dealt with a number of them (see Electrical Engineering, February 17th, page 62, February 24th, page 68), and now give the remaining results. The City of London Electric Lighting Co., after placing £50,000 to reserve, as last year, pays 8 per cent. on its ordinary shares, against 9 per cent. in 1914, and 10 per cent. in 1913; the South London Electric Supply Corporation pays 5 per cent., as in 1914; the South Metropolitan Electric Light & Power Co., 4 per cent., against nothing last year; the Notting Hill Electric Light Co., 5s. per share less tax, as last year; the County of London Electric Supply Co., 7 per cent., as in 1914; carrying £40,000 to depreciation and £14,000 forward, the latter in excess of 1914; the Chelsea Electric Supply Co., 4 per cent., against 5 per cent. last year; and the Charing Cross, West End & City Electric Supply Co. pays 5 per cent., as in 1914. The Metropolitan Electric Supply Co. has declared only 3 per cent. for the year, against 3½ per cent. for 1914, and it is rumoured that there have been divided opinions on the Board. Three directors—Lord Avebury, Sir James Pender, Bart., and Mr. P. D. Tuckett—have resigned from the Board, and Mr. J. S. Highfield has resigned his position as Engineer & Manager, and has been appointed Consulting Engineer. Capt. W. R. Rendell succeeds Mr. Highfield as General Manager.

ELECTRICAL ENGINEERING

With which is Incorporated

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SUMMARY

We publish an account of the electrical machinery sections of the standardisation rules of the American Institute of Electrical Engineers. These were drawn up in co-operation with the British Engineering Standards Committee (p. 92).

The Institution of Electrical Engineers has issued a new edition of its wiring rules. We publish an exhaustive review of these, calling attention to the various alterations from a practical point of view. Some of these are far-reaching and might well have been deferred until manufacturers are less busy (p. 93).

Our Questions and Answers page this week deals with the reversal of polarity of a shunt wound generator caused by a short circuit (p. 94).

At the Institution of Electrical Engineers on Wednesday last week a series of resolutions were agreed upon in principle by which unnaturalised enemy members shall be expelled from the membership, and naturalised members are to satisfy the Council that they have completely dropped their enemy nationality. Any member now expelled is not to be re-elected, nor can subjects of present enemy countries be elected in the future. The whole of the membership is to be asked to vote by postcard.—The Dublin Local Section wishes to go much further, and to bar from the Institution Englishmen acting as agents, now or in the future, for enemy firms (p. 95).

The Electric Vehicle Committee, in co-operation with manufacturers of lead-acid cells, has adopted a number of standards for such cells. A fresh appeal is made to central-station engineers to provide fresh facilities for charging electric vehicles (p. 97).

Mr. L. Gaster has initiated the members of the Association of Supervising Electricians into some of the principles and paradoxes of the science of "illuminating engineering" (p. 97).

We publish a description of the Drysdale phase shifting transformer—one of the most convenient appliances for the testing of A.C. supply meters and wattmeters, under conditions as to power factor, &c., identical with those obtained in practical working (p. 98).

Alterations in trunk exchanges are referred to under "Telephony" (p. 98).

Among the subjects of specifications published last Thursday at the Patent Office were A.C. commutator machines, constant-voltage dynamos, and electrodeposition on porcelain. An appeal has been lodged against the Comptroller's decision regarding opposition to a magnetic separator patent. Patents connected with dynamos, heater plugs, and watertight telephones expire this week after a full life of 14 years (p. 99).

High-tension switchgear is required at Manchester and generating plant in New Zealand (p. 100).

We refer this week to a large number of places where additions are being made to electric supply charges.—Edinburgh is to encourage the further use of electricity for heating and cooking (p. 100).

Application is being made for electricity works to be "controlled" factories (p. 100).

(*For "Arrangement for the Week" see p.* 100.)

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

(*To-day*) *Thurs., Mar. 16th:* Shooting for Sections III. and IV.

Fri., Mar. 17th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Mar. 18th: Adjutant's instruction class at 2.30 p.m.

Mon., Mar. 20th: Sections I. and II., technical. Sections III. and IV., lashings and trestle bridging. Signalling class and recruits.

Tues., Mar. 21st: School of arms, 6 to 7 p.m.

Attendance is specially desired for all members on Saturday, Mar. 25th, as it is proposed to hold Battalion drill.

AMERICAN STANDARDISATION RULES FOR ELECTRICAL MACHINERY.

SOME notes by Mr. H. M. Hobart relating to the electrical machinery sections of the standardisation rules of the American Institute of Electrical Engineers are published in last month's issue of the *General Electric Review.* In the preparation of the present edition of the rules the Committee had the co-operation of the National Electric Light Association, the British Engineering Standards Committee, and other bodies. The standardisation rules of the British Committee were issued recently (see Electrical Engineering, Nov. 18th, p. 461), and in the preface reference is made to the considerable advantage which has "accrued through the co-operation of the American Standards Committee," and it is stated that the two bodies have "gone far towards bringing about agreement on all essential details." Mention should be made of the fact that the latest editions of the British, the German, and the American Standardisation Rules have been based on the limiting temperatures for insulating materials agreed to at the last plenary meeting of the International Electrotechnical Commission, held in Berlin in 1913.

The A.I.E.E. Standardisation Rules for electrical machinery have two objects: first, to establish a standard code for acceptance tests of machinery; and, second, to provide statements of approved practice for the operation of electrical machinery in actual service. This second object is closely associated with the first, to the extent that the specified temperature limits for acceptance tests are the same as those approved for actual service. This second object differs from the first in that a statement of limits for approved practice for service conditions obviously can only be put forward as recommendations to those who have acquired the machinery, whereas for the first object the conditions for acceptance tests are mandatory for machines professing to conform with the A.I.E.E. Standardisation Rules.

The highest temperature occurring anywhere in the machine is termed in the Rules the "Hottest-Spot" temperature. It is rare that the temperature of the hottest spot can be actually ascertained by direct measurement. The highest temperatures which can thus actually be ascertained are termed "Observable" temperatures. Suitable allowances are assigned in the American Rules for the amounts by which the "Hottest-Spot" temperatures are liable to exceed the "Observable" temperatures, as ascertained by the recognised methods of measurement.

While it is admitted that insulating materials may be subjected for brief periods of time to much higher temperatures than would be safe for longer periods, it is utterly impracticable to take this into account in Standardisation Rules. In all countries which have made satisfactory progress with the standardisation of electrical machinery, limiting temperatures have been assigned to various kinds of insulating materials, on the basis that such temperatures represent approved practice for continuous operation, but shall never be exceeded in actual service even for short intervals. This rigorous principle has been adopted by the Standards Committees of Great Britain, Germany, and America, and underlies the Standardisation Rules of the International Electrotechnical Commission, which embraces not only the above three countries, but many others. The acceptance of this principle by the A.I.E.E. has involved the adoption of temperature limits considerably lower than those which could be sustained occasionally for short intervals without injury, but the margins are to be regarded as constituting factors of safety, and any encroachment whatsoever upon them is contrary to the recommendations set forth by the American Institute of Electrical Engineers as constituting approved practice.

With this understanding of the significance of the upper limits of permissible temperature, attention should now be directed to the temperature of the cooling medium, or, as it is termed in the American Rules, the "Ambient Temperature." With the variety of methods at present employed in cooling electrical machinery the term "Room" temperature no longer suffices. Some machines are cooled by the circulation through them of air led to the machines from ducts from outside of the building. Other machines are cooled by circulating water through suitably-disposed pipes. In other cases reliance is placed upon the surrounding air for effecting the cooling. The temperature of whichever medium is employed is termed the "Ambient" temperature.

While the ambient temperature will differ greatly for different cases, the maximum temperature reasonably liable to occur in any part of the temperate zone at any time of the year is adopted in the American Rules as the ambient temperature of reference. This is taken at 40° C. for air and at 25° C. for water.

So far as relates to thermal limitations, the American Rules define the rating of a machine as the continuous output which, were the machine to be operated in the ambient temperature of reference (40° C. for air and 25° C. for water), would occasion temperatures not greater than those stated to be permissible for the kinds of insulation employed.

When machines are operated in temperatures lower than the ambient temperature of reference, it is not permitted by the rules that such machines shall be used for loads exceeding their ratings as above defined.

The recommendations of the American Institute of Electrical Engineers thus provide that all the circumstances associated with the operation of electrical machines shall be such as to absolutely preclude the subjection of the insulation to temperatures in excess of those set forth in the Rules as approved practice, even for the briefest periods of time. It is obviously desirable to conform to these conservative recommendations in the operation of electrical machinery under service conditions.

The Engineering Standards Committee of Great Britain and the American Institute of Electrical Engineers have both based their Standardisation Rules upon the same fundamental principle, which is, so far as it relates to thermal characteristics, set forth in the following section of the American Rules:—

Section 263.—The principle upon which machine ratings are based, so far as relates to thermal characteristics, is that the rated load, applied continuously or for a stated period, shall produce a temperature rise which, superimposed upon a standard ambient temperature, will not exceed the maximum safe operating temperature of the insulation.

The American Rules provide for two "kinds" of rating, "Continuous" and "Short Time."

The Continuous Rating of a machine is that at which it can operate continuously without exceeding any of the limitations set forth in the Rules.

A Short-time Rating of a machine is a rating which (starting cold) it can carry for a stated short time without exceeding the permitted temperatures and temperature rises or any other limits set forth in the Rules. Thus when it is stated that a machine has a 10-minute rating of 100 kw., it is meant that if, starting cold, the machine is loaded with 100 kw., the temperature rise at the end of 10 minutes will not exceed values set forth in the Rules as approved.

For the many complicated cases of intermittent service occurring in practice, the "equivalent" continuous or short-time load (whichever is the most convenient) will be employed as its "rating."

The American Rules are framed on the assumption that reliance can be placed on a desire on the part of both parties to a transaction to live up to the spirit of the Rules. As an interesting instance of this assumption the following rule is quoted:—

Section 322.—*Duration of Temperature Test of Machine for Continuous Rating.*—The temperature test shall be continued until sufficient evidence is available to show that the maximum temperature and temperature rise would not exceed the requirements of the Rules, if the test were prolonged until a steady final temperature were reached.

The Rules contain many other clauses evincing a similar commendable spirit.

The American Rules do not set up any mandatory requirement as to the ambient temperature at the place at which the acceptance tests of machinery shall be made. The nearest approach to any suggestion on this score is contained in the last sentence in Section 320, which reads as follows:—

"It is, however, desirable that tests should be conducted at ambient temperatures not lower than 20° C."

Furthermore, the new Rules differ from the former Rules in that (with the exception of air-blast transformers) it is assumed that the temperature rise for a given load will not vary with variations in the ambient temperature. Thus, if a machine is tested in a room whose temperature is 20°, and it is found to have at its rated load a temperature rise of, say, 46°, it is assumed that at any ambient temperature, say 30° or 40° or 50°, the temperature rise for this same load would always be 46°. Thus no restrictions are placed upon the temperature of the room or of the cooling medium (*i.e.*, on the ambient temperature) at the time of the acceptance tests, the approved limits of temperature rise constituting the criterion.

In commenting on these American Rules, Mr. Hobart says that in view of the importance of continuing, in this matter of standardisation of electrical machinery, the valuable policy

of co-operation with Committees of Societies representing the various activities (both engineering and commercial) in the electrical industry in this and other countries, it is necessary to accept the fact that henceforth changes of any consequence can only be adopted in the American Rules after careful and exhaustive consultation. With the development of the art, it can reasonably be expected that the quantitative values of the limitations will gradually be modified. It is, however, highly unlikely that any alterations in the fundamental principles will be undertaken for a long time to come.

THE INSTITUTION'S NEW WIRING RULES*

WE cannot think that the Institution of Electrical Engineers has been well advised to issue a new edition of wiring rules, calling for certain alterations in current practice, at the present time. The 1911 edition had, admittedly, a few defects, but was excellent on the whole, and it would have been more expedient to have "carried on" with this edition until the time was more propitious for introducing alterations, however slight, in the prevailing methods and standard material.

Quite at the beginning of the Rules a big change is called for—an improvement, no doubt, but one for which a more opportune moment might have been chosen. Installations, whether two-wire or three-wire, connected to permanently earthed three-wire networks must have no fuse on the neutral "whether on a main or any branch circuit." It is true that, on the very next page after this rule is given, it is laid down that every sub-circuit must be protected by a fuse on each pole, and advantage can therefore be taken of the ambiguity; but, even if the rule be only applied to main fuses and main distribution boards, it would require an enormous amount of work by both supply station engineers and wiring contractors to bring all existing installations into conformity with this regulation. This omission of the fuse on the neutral, however, is not to apply when the neutral is not earthed at the generating station or sub-station, or when the earthing is always or occasionally done through a limiting resistance, so that the consulting engineer or contractor will have to make careful inquiries from the station engineer on this point before starting his work.

It is also recommended that a 3-wire linked switch should be adjusted to break the neutral connection after the outers; this is again quite desirable, but is it a time to institute changes in switch design for this purpose? A suggestion is also made that the neutral conductor should be distinguished by a yellow or white braiding; this is certainly excellent practice, but not at a time when contractors may have to wait a couple of months for standard red and black cable. A little farther on we read that conductors must in all cases be protected mechanically throughout their entire length. Quite half of the motor-starters and the larger sizes of switches and fuses are still designed for entry of the cables through bushes and not for direct connection of tubing; and while undoubtedly the latter type is preferable, it is no good specifying it when it is a question of using stock material to the fullest possible extent. Switches with handles projecting through an open slot in the cover are also definitely condemned.

All these new rules are excellent: some of them we have ourselves recommended, but, in present circumstances, it would have been advisable to postpone their issue.

Other alterations made in the new edition of the Rules are as follow:—

When supply is given from an outside source, through more than one pair of terminals, the voltages are to be marked.

Circuits within safes and strong-rooms must be controlled by linked switches on the two poles, placed outside the locked door.

All insulated conductors over 16 S.W.G. must be stranded; the maximum was 14 S.W.G. in the last edition.

Our criticism of the former rule permitting unbraided rubber cable to be drawn in conduit under certain conditions has been given effect to; but we do not think that either cable-makers or contractors will take advantage of the permission now given to use braided cable without the usual taping in casing.

Either vulcanised or pure rubber flex may be used, and the recommendation to employ the latter preferably for pendants has been withdrawn. We still advocate pure rubber flex, as there is then less liability of the wires becoming brittle either through the tinning or the sulphur from the compound rubber.

The insistence on the Engineering Standards Committee's specification for steel conduits still reads as if it excludes the use of heavier gauge than the Committee's standards. We pointed this out in the preceding edition of the Rules, and it should have been altered.

A new section permits the use of cab-tyre sheathed cable without additional protection; this sheathing is given the name "tough rubber protection."

On the other hand, wall sockets and plugs are at last called wall sockets and plugs instead of "connectors."

Connecting conductors on main boards must be so arranged that the course of every conductor may be readily traced.

The troublesome rule, habitually disregarded, that the contacts of sockets on the floor must be below floor level is retained; we prophesy that the usual position chosen will still be above and not under the carpet.

"Flexibles for portable fittings must end in a wall plug *and socket* fitted with a suitable cord grip," requires some explanation. On the other hand, the wise recommendation that cord grips should be used on portable appliances is very specific, and is repeated no fewer than three times.

The E.S.C. standard for lampholders, the obligatory enforcement of which we objected to in 1911, is no longer compulsory.

Heaters over 1,000 watts are to be fitted with D.P. switches. It would be interesting to know how many thousands will require modification to comply with this rule.

Auto-transformers are not permitted on circuits at over 250 volts.

In reviewing the last edition of the Rules we called attention to the remarkable one that all D.C. motors of over one-third h.p. should have a *regulating* switch. This has now been changed to starting switch, and, as before, a no-voltage release is required.

The insulation test before the fittings are erected is no longer compulsory, but an insulation resistance of 25 megohms divided by the number of lamps is still required for the whole *or any part* of the installation—that is to say, it is apparently expected that a single-lamp sub-circuit, say to an outside porch lamp, should test up to 25 megohms.

A useful table of the capacity of conduits is given; but we should have liked to see the conductor table extended to "flex," and also to include radial thicknesses of insulation for lead-covered cables of small size, both of which were also omitted in the previous edition.

* Copies of the New Edition of the Wiring Rules of the Institution of Electrical Engineers, just published, may be obtained from the Kilowatt Publishing Co., Ltd., 203, Temple Chambers, London, E.C., price 7d. post free, and will be sent by return of post on receipt of an order and remittance.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"Annuaire pour l'an 1916 publié par le Bureau des Longitudes." 657 pp. 6 in. by 3¾ in. (Paris: Gauthier-Villars et Cie.) 1s. 6d. net; by post, 1s. 10d.

"An Elementary Manual of Radio-telegraphy and Radio-telephony for Students and Operators." By Prof. J. A. Fleming, F.R.S. 360 pp. 9 in. by 6 in. 194 figures. (London: Longmans, Green & Co.) Third edition. 7s. 6d. net; abroad, 8s. 2d.

"The Two-Stroke Engine." By A. M. Low. 196 pp. 7½ in. by 5 in. 75 figures. (London: Temple Press, Ltd.) 1s. 6d. net; by post, 1s. 9d.

"Key to the London Telephone Directory." Vol. 2. No. 2. September, 1915, to April, 1916. 130 pp. 9¼ in. by 7½ in. (London: W. H. Smith & Son.) 5s. net.

"A Meteorological Treatise on the Circulation and Radiation in the Atmospheres of the Earth and of the Sun." By F. H. Bigelow. 431 pp. 9¼ in. by 6 in. 78 figures. (New York: John Wiley & Sons; London: Chapman & Hall, Ltd.) 21s. net; abroad, 21s. 9d.

"The Principles of Dynamo Electric Machinery." By B. F. Bailey. 314 pp. 9¼ in. by 6¼ in. 222 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 12s. 6d. net.

"The Practical Engineer Electrical Pocket-Book and Diary for 1916." 646 pp. 5¾ in. by 3½ in. 159 figures. (London: The Technical Publishing Co., Ltd.) Cloth, 1s. net; by post, 1s. 4d. Peltine, 1s. 6d. net; by post, 1s. 10d.

"The Universe and the Atom." By M. Erwin. 314 pp. 8¼ in. by 5¾ in. 58 figures. (London: Constable & Co., Ltd.) 8s. 6d. net; abroad, 9s. 2d.

"Telegraph Engineering: A Manual for Practising Telegraph Engineers and Engineering Students." By E. Hausmann. 406 pp. 8¾ in. by 5¾ in. (London: Constable & Co., Ltd.) 12s. 6d. net; abroad, 13s. 4d.

"Directory of British Manufacturers for Russian Trade, 1915." Edited by R. A. Lenski. 389 pp. 10 in. by 6¼ in. (London: Russo-British Trade Exchange, Ltd.) 5s. net; abroad, 6s.

"Wireless Transmission of Photographs." By M. J. Martin. 117 pp. 8¾ in. by 5¾ in. 62 figures. (London: Wireless Press, Ltd.) 2s. 6d. net; by post, 2s. 9d.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,486.

I have two 3-phase 25-h.p. motors driving each through a spur wheel fixed at each end of one common shaft. I find on applying current through a controller that these motors "kick" badly, and motion is very erratic. The motors run well when disconnected from the shafting, and when one motor is cut out they run almost equally well. Can any of your readers state the cause of this trouble and suggest a remedy for it?—UNICO.

(Replies must be received not later than first post, Thursday, March 23rd.)

ANSWERS TO QUESTION No. 1,484.

I am in charge of a shunt-wound D.C. generator supplying current to a small light installation. The voltage is 220. There was an accidental short-circuit in the cables leading to the brushes. The voltage at once fell down to zero and began to build up again to its normal voltage, but with the polarity now changed. Why is this?—R. H.

The first award (10s.) is made to "Y. Z." for the following reply:—

When a shunt-wound generator is loaded, its terminal volts fall from what they were at no load; first, because the total flux from the poles is reduced by the distortion due to armature reaction; second, because if the brushes are not at the neutral position they produce ampere turns on the armature, which actually demagnetise the field by acting in opposition to the field ampere turns; and third, because volts are lost in the copper of the armature winding, making the terminal volts less than the already reduced generated electromotive force. This reduction of terminal voltage reacts on the field winding when the dynamo is self-exciting, and so actually produces less ampere turns on the field winding itself; this again diminishes the generated electromotive force, and the process goes on until the ampere turns on the field just give enough flux to produce an electromotive force sufficient to give terminal volts enough to produce the ampere turns then on the field. If the load be further increased the effect is increased, and the volts come down more and more, until on a very great load—that is, when the external resistance is a short circuit of very low ohmic value—the terminal volts are zero actually. Note, however, that during the process the field ampere turns are falling off, while the armature ampere turns (and therefore the demagnetising effect of the armature) are increasing with the diminution of the external resistance. There comes a point when the armature ampere turns and the field ampere turns exactly balance and the field is destroyed; the armature current then necessarily dies down, but, being in the demagnetising direction, it sets up lines of force in the magnetic circuit of the machine in the opposite direction to those previously there, so that the remanent magnetism is opposite to what is used to be. All this takes place very quickly, of course, and represents the sudden falling to zero of the volts mentioned in the question.

If the dynamo continues running after the short circuit is removed, the permanent magnetism generates voltage in the opposite direction to the previous electromotive force. This sends current round the field in the opposite direction to the previous current, which builds up the voltage in the same direction as it has just started in, *i.e.*, opposite to the previous direction. So the machine, starting with its permanent magnetism reversed, due to the destruction of the flux following on zero terminal volts and the subsequent magnetisation by the back ampere turns of the armature, excites up again with reversed polarity.

The second award (5s.) is made to "Gamma." We give his reply, in abridged form, below:—

When the short-circuit occurs the armature current begins to rise and the field current to fall. The armature current ceases to rise when the E.M.F. induced by the field is balanced by the drop in the armature due to cross-flux, direct demagnetising effect, ohmic drop, &c. When this point is reached the main current begins to fall. The field current must reach zero before the main current, because so long as there is any field current there is a forward E.M.F. acting round the main circuit, which must be balanced by the drop due to a positive main current. The reverse does *not* hold, because the armature current cannot produce any E.M.F. in the field circuit except by induction, and this is, as we have seen, in such a direction as to oppose the field current. Hence we still have a positive current flowing in the main circuit after the field current has become zero. This current will persist for a short time owing to the inductance of its circuit, and will produce flux in the reverse direction to the normal, and will therefore leave the machine with its remanent magnetism reversed; hence, when the short-circuit is removed the voltage builds up in the wrong direction.

To put the matter in a nutshell, the field and armature tend to produce flux in opposite directions: both currents fall to zero, but owing to the fact that the field can induce a rotational E.M.F. in the armature whilst the armature cannot do the same for the field, the armature current outlives the field current, and thus leaves the machine magnetised in its own (the main current's) direction.

ANSWERS TO CORRESPONDENTS

E. D. JAMES.—Certainly not.

CRAMP & FRITH.—You are too severe on "L. R.," who, in his answer to Question 1,482, has done his best with what can obviously only be a first approximation to a design that must ultimately be determined by experiment, except that he has made a mistake of a 0 in writing out the value of the magnetic induction assumed, which is corrected in his result. The formula for L is obviously an empirical one, using the area of the coil (not of the core of the magnet), which is approximately 18·4 sq. cm. for a turn 6 ins. long. We regret that the reply has been of no assistance to you, but destructive criticism is cheap, and we would suggest that it would be better to encourage your staff to contribute to this page and assist their brethren who are faced with difficult problems.

War Tribunals.—Mr. C. Furness, the manager of the Blackpool Lighting & Tramways Undertaking, applied last week for exemption for four members of his technical staff. Out of the 107 men at the electricity works only 64 are now left, and it was made clear that the application was not on personal grounds, but because the staff at the works is at the irreducible minimum. Exemptions were granted so long as the men retained their present employment. The Clacton Borough Electrical Engineer has been successful in obtaining exemption for an electrician and switchboard attendant, on the condition that the man remained in his present occupation. On the ground that the business is not of national importance, an electrician in business at Kilburn has been refused exemption for one of his employees. Similarly, at Darlington, an electrician carrying on business on his own account has been refused exemption. This was a second application, and on the previous occasion the man had been told to wind up his business. At Islington a manufacturer of dry batteries sought exemption for one of his staff to whom he said he had imparted his trade secret. He was told that the man must either get a badge showing that he was doing Government work or someone must fill his place. An electrical engineer's assistant at Hull, whose firm has been placed on the Admiralty list, and is executing Government work, has been refused exemption. A storekeeper in the Wallasey Electricity Department has been granted conditional exemption. An assistant electrical engineer at Wigan secured three months' postponement in the case of a meter inspector and repairer and installation tester.

THE INSTITUTION AND ITS GERMAN MEMBERS

THE informal discussion by the members of the Institution of Electrical Engineers of the whole position regarding enemy members duly took place on Wednesday last week. We reported the circumstances which led up to this meeting in our last issue. The feature of the discussion was that the remarks of several members of the Council (given as members of the Institution and not as officially representing the views of the Council) showed how widely divergent are the opinions held on the Council with regard to the matter.

About 100 members attended the meeting, and took an animated interest in the proceedings, although the meeting at no time threatened to get "out of hand" as had been the case on the previous occasion. Mr. Wordingham's energetic speech took the meeting by surprise, and was greeted with long-continued applause, which lasted several minutes.

Resolutions were ultimately passed to the following effect: —Alien enemy members, including those naturalised in this country, but nevertheless still subjects of an alien country, shall cease to be members; but members from alien enemy countries who are naturalised British subjects and have ceased to be subjects of an alien enemy country shall not be excluded from the Institution. No election or re-election of members who are now subjects of an alien enemy country can take place, even after the war, until the Articles of Association are again amended to admit them.

A postcard vote of all Corporate Members is to be taken on the above points, and, if they are generally approved, the Council will then draft the necessary alterations in the Articles of Association, so that they may be submitted to the Board of Trade, and then passed at a special general meeting, at which a three-quarters majority will be necessary.

The President (Mr. C. P. Sparks), after explaining the procedure to be adopted, mentioned that a large number of communications had been received from various members. One, signed by 18 members, expressed approval of the Council's proposal which had been discussed at the previous meeting. Others expressed the hope that the alteration to the articles would exclude from the Institution all members of enemy origin whether naturalised or not. Messrs. Pearce, Walker, Allcock, Wilkinson, and W. T. Anderson suggested a similar rule to that recently passed by the Manchester Engineers' Club, which laid it down that no one of German birth or nationality should remain a member, nor could such persons be introduced as members or guests at any time. Mr. W. T. Anderson (W. T. Glover & Co.) in a separate communication asked for a resolution to be framed which would keep out Germans after the war, he believing that German commercial men will make a superhuman effort to get back here, using our institutions and clubs for the purpose. He also pointed out that the Manchester Corporation had passed a resolution prohibiting the purchase of goods from enemy countries. Mr. C. C. Aitchison, who had taken a leading part in the previous discussion, wrote regretting his inability to attend, but sent up a suggested resolution which gave effect to the views he had already expressed. On the other hand, a few members, including Capt. Creak, R.N. (retired), and Messrs. Cramp and Frith, regarded it as unnecessary to expel any members for reasons of nationality.

Col. R. E. Crompton (a Past-President) opened the discussion and urged the members not to take power out of the Council's hands, but to trust the Council. Electrical engineers should not allow it to be said of them that they suffered from hysteria.

Mr. J. S. Highfield (who is a Member of Council) said that hasty action in this matter might be regretted in the future. He then referred to the German nationalisation law which came into force on January 1st, 1914. Under the old law, if a German lives in a foreign country continuously for ten years he automatically ceases to be a German. Under the new law such a German retained his nationality unless he chose of his own volition to become a subject only of the country in which he was living. A naturalised German who did not divest himself of his nationality was quite the worst sort of naturalised British subject. He was in favour of merely giving the Council power to expel any subject of an enemy State or any naturalised British subject who is of his own volition also the subject of a foreign State, this peculiar type of naturalised British subject to be removed not only in war-time but in peace-time also.

Mr. J. H. Rider read a memorandum from Sir John Snell in which he agreed that members naturalised here but retaining their foreign nationality should be expelled. So long as a naturalised British subject was faithful to his oath of allegiance, he should not be removed from the membership, subject to that reservation. Continuing, Mr. Rider repudiated the suggestion of Col. Crompton that the members were showing signs of hysteria in this matter. He had been prepared to support the Council's resolution at the last meeting, assuming that it included the expulsion of subjects of an enemy country who had taken out naturalisation papers in the United Kingdom but still remained subjects of an alien country. He therefore submitted an amendment to this effect, which in addition left the onus of proof of absence of enemy nationality upon the member and not on the Council, and would render impossible the re-election of a member so expelled.

Mr. C. H. Wordingham said, as a member of the Council, it was a satisfaction to be able to speak openly on this highly-controversial matter, although he did not think it should be controversial among Englishmen. As an Institution it was for the members to say whether they chose to have people in their society whom some of them contemned and abhorred—personally it was an offence to him to associate with a German (loud applause)—just as he did not choose for his friends other murderers or persons of bestial habits. It might be argued that all Germans had not committed the excesses which were patent to the whole world, but the answer to that was that no German had dared to protest against them, and he maintained that every German would do the same if he were commanded to do so. Therefore he had no doubt whatever as to the propriety and justification for excluding all Germans from the Institution. He insisted on the word German because he did not class all nations in the same category as Germans. As regards naturalised Germans, the matter was admittedly extremely difficult, because some were undoubtedly English in their sentiments, and were thoroughly loyal. Some of these had lost sons in the war fighting for this country, and they must be treated as Englishmen, but there were a great many who did not come within this category. Personally he did not care whether a German was naturalised or not, because it had been proved up to the hilt that Germans naturalised in this country were here simply and solely for the benefit of their own fatherland. Many naturalised Germans here were infinitely more dangerous than the avowed Germans who had not been naturalised. It was extremely difficult to find out what these men's sentiments really were, but we must not be too careful of hurting innocent people in getting at the guilty ones. Something had been said about forgiveness, but, he said it with all reverence, God Himself does not offer forgiveness unless there are signs of repentance. Would the German nation forgive us for beating them in this war, as he hoped we should? (Loud and prolonged applause.)

Mr. W. Rutherford, another Member of Council, expressed himself in favour of expelling enemy members, but said he was not altogether in sympathy with the suggestion that naturalised enemies should be dealt with in the same way. There must, he maintained, be some differentiation in the case of men who had spent the greater part of their lives here; many of these had done good work for the country. Again, what of the Dutch and Swiss members of the Institution who were working in German munition factories? Why not deal with these and clear them out?

A Member: They have not committed atrocities.

Mr. Albert Gay (Chief Electrical Engineer, Islington Borough Council) said he wanted a vote by ballot on this question.

The President said if a majority of those present desired this, he had no objection. There might be a difficulty, as there were about eight resolutions before the meeting.

Mr. Gay, amidst laughter, said he had ballot papers with him for ten resolutions.

Continuing, Mr. Gay proposed that after the word "State" in the printed resolution of the Council should be added, "or shall be of enemy origin, although a naturalised subject of the British Empire." He concurred in all that Mr. Wordingham had said, and concluded with a reference to the four German professors who had abused the hospitality offered them in Australia at the time of the British Association meeting there in August, 1915, by actually spying at the same time. There was evidence that they had gone for that specific purpose. Three were subsequently interned, and the fourth escaped.

Mr. W. L. Madgen expressed his surprise at Mr. Wordingham's speech. There was little doubt, he said, that this country had benefited enormously by immigration. The Huguenots, a suffering people, came here and established the linen industry (A Voice: We are talking about Germany), and there were no less than 13 million Germans in the United States who had gone there to escape militarism, and who had done a great deal of good for that country. He could not understand the intense feeling that had been shown. He approved of Mr. Rider's proposal.

Mr. Ll. B. Atkinson thought it was entirely wrong of those speakers who said this matter should not be taken out of the hands of the Council. The Council, for good or bad reasons, had not done anything for 18 months, and that was why these meetings were being held. This was not a question of being afraid of Germans, but of mixing and associating with them and letting them make what use of us they desired for their own ends. This was not a question of confidence in the Council or not. At present the Council could only adopt the invidious policy of picking out individual members, and what was necessary was to have a definite course of action decided upon.

Mr. A. A. Campbell Swinton supported Mr. Rider's proposal.

Mr. L. Joseph hoped that if any neutral members were known to be working in German munition factories they would be

expelled. He also hoped that the resolution would make it clear that not only were enemy members now being turned out, but that they would not be allowed in the Institution after the war.

Mr. ARTHUR BERKELEY, in common with other members, protested against the charge of hysteria made by Col. Crompton, and said that as the views on this question of the two extremes were known, it should not be difficult to arrive at a mean between them.

Mr. CUTHBERT WIGHAM raised some laughter by protesting against the whole of the proceedings, which he characterised as "piffling." The matter was adjusting itself, as nobody was associating with Germans at the present time. Members would be better employed in helping to win the war quickly.

Mr. F. GILL, whilst agreeing that the hatred of Germans which had been expressed was proper, thought the matter should be left to the Council to deal with individually.

Mr. J. E. KINGSBURY (Honorary Treasurer) also took the view that they should deal with individual members and not enemy members as a body.

Mr. G. W. PARTRIDGE said the meeting must not think the Council as a body was pro-German; they were all anxious to do what was right. At the same time, his personal view was that enemy members who had not been de-nationalised should be expelled.

Prof. SILVANUS P. THOMPSON, F.R.S. (Past President), associated himself with Mr. Kingsbury. He did not agree with dealing with enemy members *en bloc*, as this might do a great injustice to some people, and the Council should have discretion in the matter. The definition of an alien enemy was extraordinarily difficult, for there were something like fifteen categories. There might, for instance, be members who were citizens of Hanover before 1870, when it was practically a British possession, or citizens of Frankfort naturalised before 1866, when it was practically a free city. With regard to members naturalised since January, 1914, he had made inquiries of the American Consulate in London, which had charge of German affairs, and was informed that there were none naturalised between January 1st and August 4th, 1914. Then were aliens naturalised as citizens in other countries to be turned out? Because, if so, the Institution would lose Nikola Tesla and Steinmetz. A full member of the Institution, who was happily now at liberty, had been sent to Frimley camp because he bore a German name. As a fact, he had been a student of his, and was with Crompton's for thirteen years. It was really a petty matter and a waste of time for the Institution to go through all these formalities over a handful of people. He would have been very glad to have had the whole thing shelved, but he was prepared to support the Resolution put forward by the Council, provided the responsibility remained with the Council to determine who was an alien enemy. (Loud cries of "No.")

Mr. A. C. CRAMB said he had been inclined to give the Council a certain amount of power with regard to individual members, but if the remarks from the other side of the Council table represented the majority of the members of the Council, he was not inclined to give them any power at all.

Mr. T. O. CALLENDER said he felt that after the remarks from one member of the Council, much of the feeling expressed outside as to the pro-German views of the Council were quite justified. It should not be left to the Council to decide, but there should be a clearly defined rule barring certain people of certain nationalities from membership of the Institution. The question was the extent to which this barring should take place, and in his opinion it rested with the member himself to show that he had absolutely, completely, and effectually cleared himself of his original nationality.

At this point, after the debate had occupied about two hours, the PRESIDENT said he was quite prepared to let the discussion go on if the meeting desired to adjourn for dinner and resume. If not, he proposed to take charge of the meeting in order to bring the matter under discussion into a practical form. The meeting expressed its approval of the latter course.

The PRESIDENT said that it had been at his suggestion that Members of Council had expressed their personal views at the meeting. There were most divergent views on the Council; neither Mr. Wordingham nor Dr. Thompson spoke as representing the Council as a whole, and, as he said last week, neither he nor the Council was pro-German. His own personal view was that if a German came here and absolutely gave up his nationality, he should be looked upon as a Britisher, and should not be deprived of membership of the Institution.

The PRESIDENT then asked members to vote upon the general principles which had to be decided, and the following resolutions were passed :—

(1) The meeting was practically unanimously in favour of expelling subjects of enemy countries.

(2) A similar practically unanimous resolution was passed in favour of expelling subjects of enemy countries who have not divested themselves of their enemy nationality.

Whilst the President was putting this point, Dr. Thompson remarked that there are not any. The President's rejoinder was that no harm would therefore be done in passing the resolution. Personally he believed there were a few.

(3) The meeting voted by a considerable majority that members formerly subjects of enemy countries, but who had definitely lost their previous nationality, and were able to prove it to the full satisfaction of the Council, should not be expelled.

Mr. J. H. RIDER reminded the President as to the question of electing or re-electing enemy members in the future.

Mr. MORDEY expressed the hope that the Institution would not bind the hands of future Councils too much.

The PRESIDENT asked if Mr. Rider meant that after the war was over German subjects should be prevented from becoming members.

Mr. RIDER: Yes.

After some discussion, this principle was carried by 40 votes to 21.

The PRESIDENT said the whole of the members would be asked to express an opinion by postcard upon these resolutions. If the members desired, the Council would draft the wording of the resolutions for this postal vote, or a committee of the members could be appointed to consult with the Council.

Eventually it was decided to appoint Messrs. Ll. B. Atkinson, A. A. Campbell Swinton, F. Gill, and J. H. Rider as representing the members, and the four Vice-Presidents, Messrs. J. S. Highfield, Roger Smith, C. H. Wordingham, and Dr. Alexander Russell (with Mr. Sparks as Chairman) to put into words the general principles adopted by the meeting.

The proceedings then closed.

At a largely-attended general meeting of the Dublin Local Section of the Institution of Electrical Engineers, held at the Royal College of Science, Dublin, on Friday, the 10th inst., the following resolutions were passed :—

(1) That this meeting is of opinion that the membership of the Institution of any citizen born of alien enemy parentage, naturalised or not naturalised, shall forthwith cease, and that after the termination of the war no such citizen shall be eligible for membership; and further, that any citizen of the Empire or allied or neutral nations, being a member of any grade of the Institution, who becomes an agent for a firm owned or controlled by citizens of those enemy nations, shall automatically cease to be a member.

(2) That the Chairman, Hon. Secretary, and another be deputed to attend the general meeting to be held in London to support the terms of the foregoing resolution.

INDUSTRIAL LIGHTING

A PAPER on "Recent Progress in Industrial Lighting" was read by Mr. L. Gaster before the Association of Supervising Electricians on Feb. 29th. The author called attention to the numerous types of filament now in use in different lamps, each giving different light distribution, and pointed out that a higher candle-power in a particular direction does not necessarily mean that the lamp, as a whole, gives out more light. Referring to half-watt lamps, he suggested that makers should give some indication to the public as to the circumstances in which it pays to use these rather than ordinary lamps, having regard to the shorter life and the higher cost of the lamps. Quoting from the "Code on Factory Lighting," issued by the American Illuminating Engineers' Society, he gave the following figures for the desirable illumination of industrial premises: Storage, passageways, stairways, &c., 0·25 to 0·5 ft. candles. Rough Manufacturing operations, 1·25 to 2·5 ft. candles. Fine manufacturing, 3·5—6 ft. candles. Special cases of fine work, 10—15 ft. candles. He next explained how the illumination given by standard types of reflectors could be worked out by the polar curves or other data issued by the makers, and suggested that the reflection from the walls and ceilings should be left out of account. The difficulty of arranging the lights according to any hard and fast rule was unconsciously demonstrated by the author in two consecutive paragraphs in his Paper. He quotes the American "Code on Factory Lighting" to the effect that lamps should be 12 to 16 ft. above the floor, and rated to give 1 c. ft. per sq. ft., then explains that this assumes the employment of reflectors designed to screen the source of light from the workers. Taking the Paper as a whole, however, there is no doubt that the Supervising Electricians will have gained some useful hints as to the principles of illumination from incandescent lamps.

Electric-light Switching Competition.—We are informed by Messrs. A. P. Lundberg & Sons that all past records have been well beaten in regard to the number of answer papers received in respect of the examination questions sent out by them last month. We also understand that the quality of the papers is exceptionally high in all three grades. For the first time, the ladies have entered the field! There are still the papers to come in from overseas competitors, who are naturally given a longer time to compete.

THE ELECTRIC VEHICLE COMMITTEE

A MEETING of the Electric Vehicle Committee was held in London on February 18th, Mr. A. C. Cramb presiding in the enforced absence, through indisposition, of Mr. R. A. Chattock.

The Committee had before them very favourable figures in connection with the increasing circulation of their official publication, *The Electric Vehicle*, subscribers being now numbered in all parts of the world. Owing to his position in connection with the production of munitions in the London area absorbing the whole of his time, Mr. Seabrook has had to relinquish, for the time being, the honorary editorship, the work having been temporarily undertaken by the Secretary.

Some time ago the Committee asked the Accumulator Manufacturers' Section of the British Electrical and Allied Manufacturers' Association, through their representatives on the Committee, to consider the possibility of further standardisation of lead-acid accumulators for electric vehicles, particularly in regard to rating and the overall sizes of cells. The Committee at this meeting considered a communication from the Accumulator Manufacturers' Section of the B.E.A.M.A., stating that they were prepared to agree to the standard sizes and rating set forth below, which the Committee consider satisfactory for present requirements. These have, with the co-operation and assistance of the manufacturers, been standardised, and will be known as E.V.C. standards, but it is hoped that, in due course, the British Engineering Standards Committee may give them the mark of approval by adopting them as British standards. Purchasers of electric vehicles, when lead-acid cells are intended to be used, are urged to insist that in rating and construction they shall be in accordance with the E.V.C. standards, which are now as follows:—

"*E.V.C." Standard Rating.*—This shall be the capacity in ampere-hours obtained by a continuous discharge at a uniform rate for a period of five hours until the voltage of the cell falls to 1·7. Example: If a battery is specified to have an "E.V.C." standard rating of 180 ampere-hours, it means that the battery will give this capacity when discharged at a continuous rate of 36 amperes for a period of five hours, at the end of which time the voltage per cell shall not have fallen below 1·7 volts.

"*E.V.C." Standard Plates.*—Height, $8\frac{5}{8}$ in.; width, $5\frac{3}{4}$ in.; lug centres, $4\frac{3}{8}$ in.

"*E.V.C." Standard Overall Sizes.*—For all sizes the width of the cell shall be $6\frac{5}{16}$ in., and the overall height, including connector, $14\frac{7}{8}$ in. The length of the smallest size—*i.e.*, that with seven plates—shall be $2\frac{7}{16}$ in., with the addition of $\frac{5}{8}$ in. for each pair of plates above seven plates.

An exception is in the case of the Chloride Accumulator Co.'s "Ironclad-Exide" type of cell, in connection with which the length of the seven plate size is $2\frac{3}{4}$ in., with the addition of $\frac{3}{4}$ in. for each pair of plates above seven plates.

"*E.V.C." Standard Inspection Plug.*—Shall be that which will fit a hole in the cover of the cell 1 in. in diameter.

"*E.V.C." Standard Charging Voltage.*—Shall be that which is suitable for charging 44 lead-acid cells—*i.e.*, 85 to 120 volts.

The Secretary reported that since the October meeting subscriptions and donations had been received amounting to £56 14s.

The Committee have again undertaken to award money prizes amounting in all to a sum of £10 at this year's annual parade and inspection of Motor Vehicles, to be held under the auspices of the Commercial Motor Users' Association.

The Committee have had brought to their notice difficulties which are being experienced in a few of the districts bordering upon the London area by electric delivery vehicles, operating from London on long delivery routes, in getting boosting charges. The difficulties consist in either delay in getting connected up for charging, owing to there being no permanent connection for the purpose, or, on the other hand, the exorbitant price charged for the service. The Committee appeal to all central station engineers to adopt, where they have not already done so, the Committee's standard tariff of 1d. per unit for "off peak" charging, with a minimum of 2s. per charge (24 units at 1d.) to include all connecting-up and disconnecting. By charging exorbitant prices, an undertaking is not only spoiling any chance there might be of getting the electric vehicle load in its own district, but, in the case of the districts around London, may thereby be the means of preventing a neighbouring and progressive undertaking from getting the fullest possible benefit from the steps it is taking to encourage the use of electric vehicles. All that is necessary is a permanent (for the time being) connection from the switchboard bus-bars through a d.p. switch and fuses, or a maximum overload circuit-breaker, through an adjustable water resistance to a British standard charging plug. If, perchance, there is a booster set or an exciter in the station, giving about 120 volts that can be used for this purpose when required, so much the better. The proper and permanent charging plant can be put in when the first car is put into permanent use in the district.

Coal Supplies.—Having regard to the difficulty experienced by electricity supply undertakings in obtaining coal, a suggestion by Mr. H. B. Renwick, managing director of the County of London Electric Supply Co., that an Advisory Committee or Board should be set up by the Government to regulate supplies has much to commend it.

"EYE-REST" IN CO-OPERATIVE STORES

ONE of the largest co-operative stores in the North of England has lately been erected by the West Hartlepool Co-operative Society, and the British Thomson-Houston Co.'s well-known "Eye-Rest" system has been adopted practically throughout the building. The lighting points number 530, and the wiring work was entrusted to Mr. Edgar Phillips of West Hartlepool.

The accompanying illustrations, reproduced from untouched

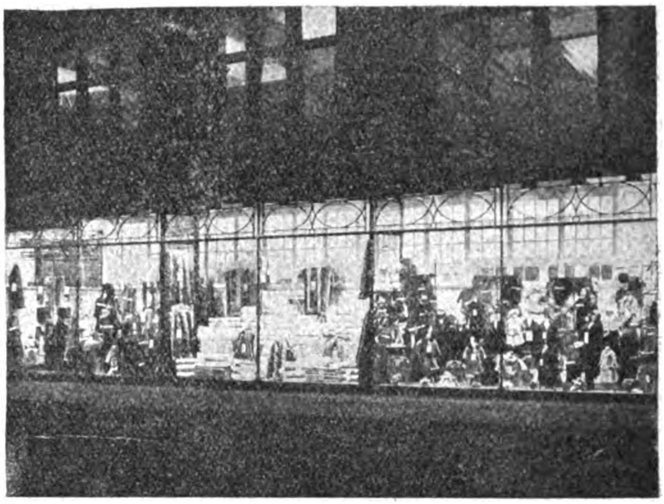

FIG. 1.—WINDOW LIGHTING.

photographs taken by the light of the fittings installed, will convey some idea of the excellent results secured. Standard Mazda lamps in conjunction with "X-Ray" helmet-type reflectors, are employed in the windows shown in Fig. 1, spaced at approximately 3 ft. centres. For the lighting of the haberdashery and other departments where a counter trade is conducted with articles of small size and various colours, "Eye-Rest" brass bowl fittings are employed, each containing six standard 60-watt "Mazda" lamps.

A novel feature is the lighting scheme in the mantle department. This department has a floor space measuring 70 ft. by

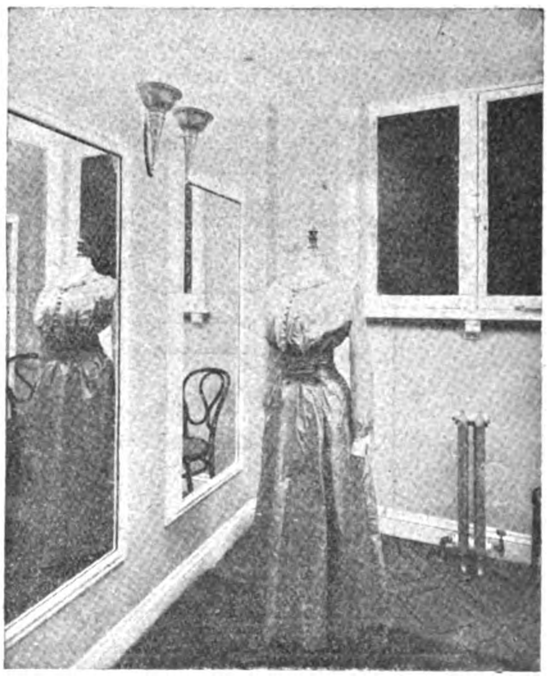

FIG. 2.—A FITTING ROOM.

50 ft., and is equipped with 14 "Eye-Rest" fittings with 24-in. brass bowls. These fittings take care of the general lighting, which has an average value of about 4 ft. candles. The novel feature is in connection with the showcases, all of which are lighted independently by "X-ray" reflectors, countersunk in the top of case, each reflector containing one 60-watt standard lamp. By this means, the articles of clothing exhibited are brought into prominence, all disagreeable shadow and glare being eliminated. The numbers of units vary with the size of the showcases.

In the offices, and oak-panelled board room, "Eye-Rest"

fittings and Mazda lamps are also employed, and an average of 4 ft. candles is secured in the latter room. In the café which is provided for the use of customers, which measures 40 ft. by 38 ft., four "Eye-Rest" brass bowls, each equipped with six 60-watt Mazda lamps, are employed. The average requirement for restaurant lighting is 2·5 ft. candles, and here, as in most of the departments, we are informed that the estimated illumination has either been reached or exceeded.

Fitting rooms in tailors' or dressmakers' shops are always difficult to light successfully. They are usually of small size, with mirrors on all sides. At the West Hartlepool Society's fitting rooms, most satisfactory lighting has been secured by the use of a pair of two-light flambeaux "Eye-Rest" wall brackets, placed on opposite sides of room, each fitted with two-standard 40-watt lamps. The average illumination obtained is no less than 6 ft. candles.

DRYSDALE PHASE-SHIFTING TRANSFORMER

This most useful appliance for testing supply meters and wattmeters is now being manufactured by H. Tinsley & Co. (Eldon Park Works, South Norwood, S.E.), who have sent us an illustrated descriptive pamphlet. The windings of the transformer, which is shown in Fig. 1, are placed on a stator and rotor in a similar manner to the windings of

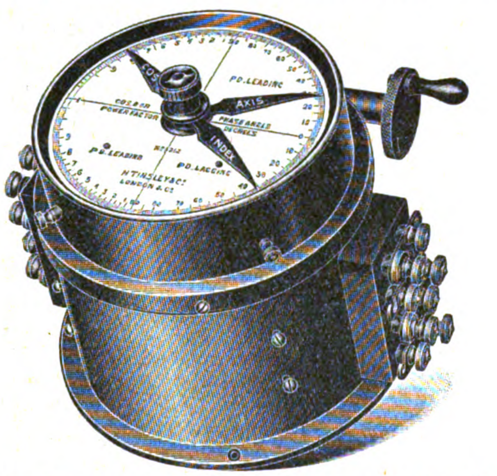

Fig. 1.—Phase-shifting Transformer: 1/3th Full Size.

an induction motor with wound rotor. The rotor is mounted on a vertical shaft, which can be turned by worm gear and clamped in any position. When the stator winding is supplied with two- or three-phase current, or with single-phase current if a phase-splitting device is used, a rotating magnetic field is produced, and an E.M.F. is induced in the rotor secondary,

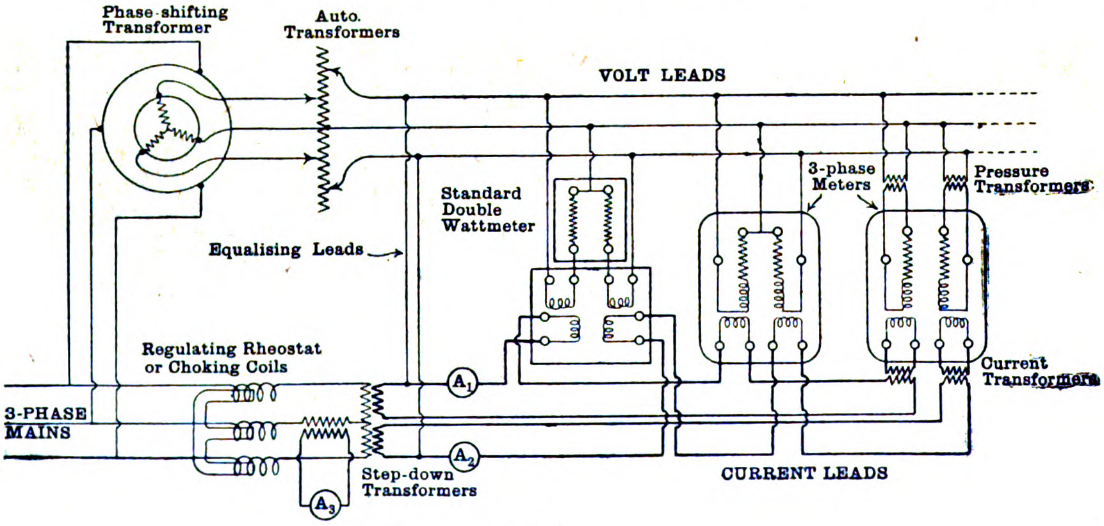

Fig. 2.

constant in value but differing in phase from the primary E.M.F. by an amount depending on the angle through which the rotor is turned. Thus any power factor can be obtained.

The method of testing meters is indicated by the diagram of connections shown in Fig. 2. The current coils of the meters are supplied direct from the mains through step-down transformers; the volt coils are supplied from the same mains through the phase-shifting transformer, so that the current through them can be set to any desired phase position relatively to the current through the current coils. The connections shown thus maintain the meters under test in electrical conditions identical with those of practical working. Where single-phase supply only is available, a phase-splitting device is, of course, required.

The transformers are at present made in two sizes, rated at 250 and 750 volt-amperes respectively. The smaller size, Fig. 1, amply covers ordinary meter testing up to 50 meters at a time, at 100 volts. The larger size is required for high-voltage meters where it is necessary to transform the P.D. to five or ten thousand volts.

A special feature of the transformers is that both the stator and rotor windings are well distributed round the periphery, so that if the former is supplied from a source of good sine-wave form, the secondary P.D. will also be sinusoidal at all loads and power-factors.

VOLTITE RUBBER JOINTING STRIP

We have received from the Wholesale Electrical Co., Ltd. (54-56 Oxford Street, London, W.), a sample of Voltite rubber jointing strip. In appearance it resembles the ordinary pure rubber used for joints, and it stretches equally well, so that a tight joint can be made. The principal feature of the material, however, is that the tape is very adhesive, and if put on with a fair tension and only very slightly warm (the mere warmth produced by handling it may suffice), will adhere and make a good joint without the lavish application of rubber solution which is necessary when employing ordinary pure rubber.

We have also received from the same Company another of their "Canfield" electrical jointing specialities, namely, a good black adhesive tape of the sticky variety, which should also prove of distinct utility. Both tapes are of American manufacture, the Wholesale Electrical Company being the sole selling agents, and we understand that the Company holds a good stock for immediate delivery.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

The last number of the Post Office Electrical Engineers' *Journal* contains an interesting article by I. J. Jenkins and W. White, describing the development which has taken place in the trunk circuit arrangements since the taking over of the entire telephone system of the country by the Post Office. The necessity for having all trunk exchanges entirely separate from local exchanges ceases to exist, and of the original 287 trunk exchanges at the time of the transfer, no fewer than 217 have already been closed; it is intended ultimately to have only about 12 separate trunk exchanges throughout the kingdom. The shorter trunks will be operated on a "junction" basis—that is to say, that circuits will be so arranged that the control of the connection is in the hands of the

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published March 9th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

12,282/14. **A.C. Machines.** A. HEYLAND. A polyphase commutator machine characterised by the combination of a chord winding on the rotor with brushes on the commutator short-circuited in pairs in different axes according to the number of phases, or connected by circuits of low tension, the brushes bearing on parts of the commutator, the angular distance apart of which is greater or less than the angle between the axes of the several phases of the stator winding. (Five figures.)

2,618/15. **Constant-voltage Dynamos.** CROMPTON & Co. and N. PENSABENE. A dynamo giving constant voltage over a considerable range of speed variation, and also capable of being run as a high-torque motor for starting internal combustion engines, with two windings on the armature, one consisting of an ordinary D.C. winding with a commutator, and the other of a superimposed distributed A.C. winding, either short-circuited or connected to resistances through slip-rings so that the A.C. reaction reduces the flux cutting the D.C. winding as the speed increases, causing the E.M.F. generated to be approximately constant. The additional winding also acts as a compensating winding, and improves the commutation. (Five figures.)

2,698/15. **Electro-deposition.** P. MARINO. A process of rendering the surface of unglazed porcelain or pottery, roughened glass, &c., conductive, so that metallic coatings can be deposited thereon electrolytically, by painting the surface with an ammoniacal solution of an arsenite, ammonium, fluorhydrate, and double nitrate of silver and ammonium, and afterwards with hot caustic potash or soda.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Dynamos, Motors, and Transformers: CLIFTON [Motors] 2,516/15.

Ignition: BELL [Magnetos] 17,172/15.

Switchgear, Fuses, and Fittings: HOLT [Circuit-breakers] 3,001/15; ANDERSON [Switches] 3,657/15; TUCKER and CRABTREE [Fuseboards] 3,763/15; DYSON [Conduit fittings] 8,294/15; GILES [Excess-voltage protection] 15,196/15.

Traction: HIBBERT [Signalling] 10,438/15.

Miscellaneous: NEWMAN and NEWMAN & SINCLAIR, LTD. [Magnetic compass] 3,122/15; REID and CALLENDERS CABLE & CONSTRUCTION Co. [Calculating apparatus relating to power transmission] 7,269/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

(Numbers in brackets refer to the new system of numbering.)

Electrometallurgy: W. J. WRIGHTON [Electric furnace] 2,584/16 *(100,093)*.

Heating: LANDIS & GYR A.G. [Heating apparatus] 18,069/15.

Ignition: R. BOSCH [Interrupter] 17,921/15.

Incandescent Lamps: R. BOSCH [Projector lamp] 17,542/15.

Telephony: NAAMLOOZE VENNOOTSCHAP DE NEDERLANDISCHE MAATSCHAPPIJ [Thermic telephones] 5,842/15 and 1,862/16 *(100,084)*.

Miscellaneous: H. R. VAN DEVENTER [Condensers] 955/16 *(100,081)*; F. P. BAUMANN [Dry batteries] 2,056/16 *(100,086)*.

Opposition to Grant of Patents

2,865/15. **Magnetic Separation.** A. J. NEWELL. An appeal has been lodged against the decision of the Comptroller, as the result of opposition, requiring certain amendments in this specification which describes apparatus for extracting magnetic impurities from paper pulp as it passed through the machine.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

6,666/02. **Dynamos and Motors.** J. H. ST. H. MAWDESLEY. A design of machine with S- or Z-shaped field magnets excited by a single field winding.

6,733/02. **Plugs for Heating Circuits.** W. D. KILROY. A prismatic-shaped plug which, when inserted into the socket different ways round, puts different combinations of heating elements into the circuit.

6,884/02. **Telephones.** A. GRAHAM. A watertight construction of telehone instrument.

The following are the more important patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: B.T.-H. Co. *(G.E.Co., U.S.A.)* [Phase advancing systems] 25,556/08.

Heating and Cooking: R. K. HEARN [Thermal cut-outs for heating appliances] 25,485/08.

Incandescent Lamps: F. C. DAFFORN [Candle lamps] 25,519/04.

Switchgear, Fuses, and Fittings: J. J. RAWLINGS, H. W. HANDCOCK, and A. H. DYKES [Methods of fixing fittings for metal-cased wiring] 25,461/08.

Miscellaneous: B.T.-H. Co. *(G.E. Co., U.S.A.)* [Electrically-operated doors] 25,630/04.

A operator, whose supervisory signals are controlled by the subscribers' switch hooks in the case of an ordinary C.B. or C.B.S. exchange. The limit for such circuits has been fixed for trunks up to 60 route miles in length. Above this length the trunk lines are worked on a magneto call and loop current basis. In the equipment the principle has been adopted that the C.B. manual exchange is regarded as a standard, and in the case of non-C.B. exchanges working to C.B. exchanges apparatus is associated with the line at the non-C.B. end to produce C.B. signalling conditions, and so to link up the two systems. The principle of inserting a repeater between the trunk line and a subscriber's or a junction line has been followed in order to ensure against the risk of the trunk line being degraded by direct connection to a faulty or unbalanced line.

A dividend of 4 per cent. on the ordinary shares for 1915 has been declared by the Automatic Telephone Co., carrying forward £6,774.

Train Lighting.—The Board of Trade report upon the accident on the North-Eastern Railway Co.'s line near Jarrow on December 17th deals at length with the question of gas lighting. Lieut.-Col. Von Donop expresses himself strongly to the effect that electricity should replace gas for train lighting. The evidence in this case, he holds, points to the fire having originated with the ignition of gas escaping from one of the cylinders. Similar evidence has existed, he points out, in previous cases, but in this instance it is more definite than in any previous case, and "it furnishes, therefore, a very conclusive object-lesson as to the additional danger which is caused in the case of an accident by the presence of gas on the train." Attention is called to the steps which the North-Eastern Co. has taken during the last three years to fit all new passenger stock with electric light, but an appendix to the report shows that of 4,242 coaches owned or maintained by the Company, only 626 are lighted by electricity. The Board of Trade inspector concludes with the hope that the occurrence of the fire in connection with this accident may lead the company to the adoption of a definite decision in favour of electric lighting for all new stock and for the gradual conversion of the gas-lit stock.

Obituary.—The death took place at Sidcup, on the 6th inst., of Mr. R. A. Dawbarn, at the age of 55. For the last 15 years Mr. Dawbarn has been in partnership with Mr. W. M. Mordey as consulting engineer. He has been associated with the electrical industry, however, from the very beginning, having held an appointment with the British Electric Light Co., which was the first electric supply company to be established in this country. Subsequently he was with Messrs. Siemens Bros. & Co., and later with the Brush Co. He was with the latter from 1888 until 1900, when he joined Mr. Mordey.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Manchester.—The Electricity Committee requires 6,600-volt three-phase switchgear at Stuart Street Station. Chief Electrical Engineer, Dickinson Street. March 22nd.

New Zealand.—The Wanganui Borough Council require additional plant for its power-house. Further particulars at 73 Basinghall Street, E.C.

Miscellaneous

London: *H.M. Office of Works.*—Twelve months' supply of main switches, fuses, &c. (See an advertisement on another page.)

South Africa.—The Commercial Intelligence Department of the Board of Trade, 73 Basinghall Street, has the specification, &c., for 5,106 train lighting cells for the Tender Board, South African Railways Headquarters Office, Johannesburg.

Whitchurch.—The Welsh Metropolitan War Hospital requires six months' supply of electric lighting stores. Clerk, Whitchurch, near Cardiff. March 23rd.

APPOINTMENTS AND PERSONAL NOTES

Mr. W. A. Scott, A.M.I.E.E., Works Manager of Bruce Peebles & Co., Ltd., Edinburgh, was married on the 9th inst. to Alexandrina, second daughter of Alexander Mann, Edinburgh. A few days prior to the wedding Mr. Scott was presented with a handsome canteen of cutlery and a silver cigarette-case by his many friends amongst the workmen and staff.

Mr. W. C. Turner, who left the Rotherham Corporation Electricity Works in 1910 to take up the position of mains superintendent to the Madeira Electric Light Co., at Funchal, has been promoted to the post of resident engineer and manager to the Company.

At Messrs. Siemens Bros. & Co.'s, Ltd., Woolwich Works, on Monday, the 6th inst., Mr. Robert Bertram, of the Despatching and Receiving Department, was presented with an illuminated address and a cheque from his colleagues, and also a cheque on behalf of the Company, on the occasion of his completing fifty years' service with the Company.

There are several vacancies at military high-tension power stations. (See advertisement.)

The Hammersmith Council want an Engineer-in-Charge; also a stoker. (See advertisement on another page.)

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £135 to £137 (last week the same).

Shipping Congestion.—The French Government, having regard to the state of congestion of the Port of Havre, request British exporters of goods for Switzerland to send as little as possible by that route.

Football Challenge Cup.—An interesting football match was contested on Saturday, March 4th, between the Ediswan Lamp Works (Glass Department) and Siemens Bros. Dynamo Works, Ltd., for the Siemens Silver Challenge Cup. The honours went to the Ediswan team, who won by 3 goals to 1. The proceeds of the match are to be utilised in providing comforts for the local men on active service.

An "Ediswan" Hospital Gift.—The staff and employees of the Ediswan Company have made a present of a piano to the Edmonton Military Hospital.

Electricity Works as Government Controlled Factories.—A number of borough electrical engineers are making application to the Ministry of Munitions for certificates that the electricity undertakings come within the terms of the Munitions of War (Amendment) Act, 1916. There are several reasons for this step, not the least important being, of course, that relating to the retention of staff. As we have previously pointed out, the fact that employees of electric supply undertakings may leave at will in order to take up better posts available solely through the war has caused inconvenience in many places.

LOCAL NOTES

Electric Supply Charges.—Electricity supply undertakings throughout the country, both company and municipal, find their working costs still going up owing to the increased cost of coal, labour, and materials, and in consequence further additions are being made to the charges to consumers. Last year the Metropolitan Electric Supply Co. added 10 per cent. to their tariffs, and now announce a further 10 per cent. addition. From the March quarter the Hornsey Borough Council is adding 10 per cent. to consumers' bills, and the Burnley Electricity Committee has submitted a revised list of charges showing an all-round increase for lighting, heating, traction, and motive power. The Leeds Electricity Committee is also compelled to increase the price of current from April 1st by 10 per cent., the main reason here again being the increased cost of coal, which amounts to some £16,000 per annum than before the war. At Birmingham an increase of 15 per cent. on all charges for lighting and 20 per cent. for power purposes is recommended by the Electric Supply Committee. As mentioned below, the Hampstead Borough Council also proposes a 10 per cent. increase, whilst at Burton-on-Trent 15 per cent. is to be added to consumers' accounts from the March quarter.

Edinburgh: *Lighting Charges.*—The Electric Lighting Committee has decided to try as an experiment for one year a new method of charging for electric lighting purposes by which the ordinary lighting rate is charged for a certain number of hours, after which the power rate comes into force. The object of this is to induce consumers to make a larger use of electric heating and cooking apparatus, and to obviate the necessity for two meters, &c.

London: *Hampstead: Estimated Deficit.*—It is calculated that for the year ending March 31st, 1916, there will be a deficit of £3,528 on the electricity undertaking owing to the abnormal increase in the cost of fuel, and also to reduced revenue. The Electric Lighting Committee recommends that the deficit be met from the reserve fund. In order to meet the increase in the current year charges are to be raised by 10 per cent.

Middlesbrough: *Electricity Profits.*—The Finance Committee has decided that no profits shall be taken from the electricity undertaking in relief of rates, as, owing to the Local Government Board's refusal to sanction capital expenditure for mains and extensions during the war, it will be necessary to utilise profits for this purpose during the ensuing year. Last year the Electricity Department contributed £2,000 to relief of rates.

Nottingham: *Contracts with Enemy Firms.*—The City Council on Monday unanimously decided to support the principle that no contract shall be entered into by any municipal body with any person of German or Austrian nationality or with any firm or company whose capital is held or controlled to the extent of one-third or upwards by persons of such nationalities.

Wigan: *Position of Electrical Undertaking.*—The President of the Institution of Electrical Engineers and the I.M.E.A. having nominated a number of electrical engineers from whom the Corporation should select an expert to advise with regard to the general position of the electrical undertaking, the choice has fallen upon Mr. S. L. Pearce, City Electrical Engineer of Manchester.

Arrangements for the Week.—(*To-day*) *Thursday, Mar. 16th.*—Institution of Electrical Engineers. The Use of Continuous Current for Terminal and Trunk Line Electrification, by N. W. Storer. 8 p.m.

Friday, Mar. 17th.—Electro Harmonic Society Smoking Concert, Holborn Restaurant. 8 p.m.

Tuesday, Mar. 21st.—Institution of Electrical Engineers, Manchester Section. Engineers' Club, Albert Square. "The Possibilities in the Design of Continuous Current Traction Motors," by N. W. Storer. 7.30 p.m.

Faraday Society.—At Institution of Electrical Engineers, Victoria Embankment. Discussion on "Methods and Appliances for the Attainment of High Temperatures in the Laboratory," to be opened by Dr. J. A. Harker, F.R.S.

ELECTRICAL ENGINEERING

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Small Advertisements and Official Announcements, *Wednesday first post.*

Displayed Advertisements, *Tuesday first post.*

Corrections in Standing Advertisements, *Monday first post.*

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SUMMARY

A Paper by Mr. N. W. Storer on the use of continuous current for terminal and trunk-line electrification points to the necessity for the early standardisation of some of the more important features connected with electrification (p. 102).

A Paper on continuous-current railway motors, by Mr. E. B. Pannell, was read at the Institution of Electrical Engineers' last Thursday. Some modern tendencies in motor design were discussed (p. 103).

A number of books are reviewed on p. 104.

Two 0·5 sq. in. 11,000-volt 3-core submarine cables, over 2½ miles long, have been successfully laid across a tidal estuary in the United States (p. 105).

Some features of the design of the million-volt transformer installed at the Panama-Pacific International Exposition are described. The transformer is of the rectangular core type with all the windings on one limb (p. 106).

In a Paper entitled "Notes on the Modernising of an Electric Supply Undertaking," read before the Liverpool Engineering Society, Mr. E. U. Hollingsworth described the extensions and improvements made in connection with the St. Helens Corporation undertaking since 1908 (p. 106).

Our Questions and Answers page this week deals with the "V" connection of two single-phase transformers on three-phase circuits (p. 107).

Among the subjects of specifications published by the Patent Office last Thursday were distribution boards, voltage regulators, and cable calculators. Patents relating to electro-deposition and railway signalling have been granted in spite of opposition (p. 108).

An authoritative article on lightning has been published by Prof. Elihu Thomson and others, in which some of the risks due to lightning and the means of avoiding them are discussed (p. 109).

Electrical stores are required at Rathmines, Liverpool, Edinburgh, &c. (p. 110).

The Charing Cross, West End & City Electricity Supply Co. is applying for an increase in its maximum price until 12 months after the conclusion of the war.—There will be a loss of £6,000 upon the Yarmouth electricity undertaking for the current year (p. 110).

A dividend of 5 per cent. has been declared by W. T. Glover & Co.; the British Westinghouse Co. has declared 7½ per cent. on its preference shares; the Newcastle Supply Co. has declared 6 per cent. dividend, an increase of ½ per cent., but the Newcastle & District Co., although showing increased profits over last year, declares no dividend (p. 110).

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D.

Drills, 6.25 to 7.25: 7.25 to 8.25 p.m.

Thurs., Mar. 23rd: Shooting for Sections I. and II., and signalling class.

Fri., Mar. 24th: Sections III. and IV., technical. Sections I. and II., lashings and trestle bridging. Signalling class and recruits.

Sat., Mar. 25th: Uniform parade at 2.45 p.m.

Mon., Mar. 27th: Sections I. & II. technical. Sections III. & IV., squad. and platoon. Signalling class and recruits.

Tues., Mar. 28th: School of Arms, 6.0 to 7.0 p.m.

Thurs., Mar. 30th: Shooting for Sections III. & IV.

Fri., Mar. 31st: Sections III. and IV., technical. Sections I. & II., squad. and platoon. Signalling class and recruits.

Sat., Apr. 1st: Adjutant's instruction class at 2.30 p.m.

Sections for technical parade at Headquarters, London Electrical Engineers, 46 Regency Street, S.W.

Sections for shooting parade at Miniature Ranges.

Arrangements for the Week.—*Monday, March 27th.*—Electrical Trades Benevolent Institution annual meeting at Institution of Electrical Engineers, Victoria Embankment. 2.30 p.m.

Wednesday, March 29th.—Institution of Electrical Engineers. Students' meeting. 7.45 p.m.

"The Electric Vehicle."—The March quarterly number of "The Electric Vehicle," the official organ of the Electric Vehicle Committee, is as usual filled with interesting matter regarding the increasing use of electric battery vehicles. One of the features deals with the choice of an electric vehicle, in which practical hints are given to intending buyers, whilst the list of electric vehicles in use or on order in Great Britain continues to expand. Illustrations are given of the vehicles and the ambulances used by the Port of London Authority, and a number of other interesting applications are illustrated.

RAILWAY ELECTRIFICATION

The Use of Continuous Current

A PAPER by Mr. N. W. Storer on "The Use of Continuous Current for Terminal and Trunk-line Electrification" was read at the Institution of Electrical Engineers at Birmingham on March 15th and in London the next day. The Paper dealt chiefly with the characteristics and possibilities of the D.C. motor, having regard to interchanging equipments on lines where different conditions prevail. It advocated the series type. Two such motors were compared, one with saturated and the other with unsaturated magnetic circuits. For frequent stopping service the unsaturated motor, the author said, would operate more efficiently, since it accelerates with so much less current. The difference is still more pronounced on overloads. This also brings out the fact that the heating current, or the root-mean-square current, as it is commonly known, will be very materially decreased in the unsaturated motor for a given service, and, consequently, an unsaturated motor of a given rating will have a greater service capacity; or, with equal margin for a given service, an unsaturated motor will require a smaller rating than a saturated motor compared on either the 1-hour or continuous basis. If this point were thoroughly borne in mind, the manufacturer of the unsaturated motor would not be penalised on account of small rating, or on account of greater weight with equal ratings, and the railway company would operate with greater efficiency. It was also pointed out that a field-control motor is not materially heavier for a given service than the simpler form of series motor, though it may have a lower rating.

The subject of regenerative control was treated, and it was pointed out that any such scheme may be supplemented by elevated station tracks as used on the Central London Railway. A scheme is already nearly developed, which, the author hoped, will soon be in commercial operation, involving the use of the standard series motor, with separate excitation during regenerative periods. The control may be entirely automatic from the time it is applied until the lowest speed is reached at which the motors when connected in series can develop the line voltage. At the same time it can be stopped at any desired speed. The regeneration at high speed is with the motors connected in parallel, and the change from parallel to series is effected by a bridging method especially adapted to this purpose. There is no break in the retardation of the train from the maximum speed until it comes to a standstill; for the control is so arranged that the air brakes may be applied as soon as the minimum regenerating speed is reached. The use of the standard series motor in this connection, said the author, is of the greatest importance, and it is also noteworthy that the motor designed for field control also assists in securing the maximum saving of energy owing to the fact that the regeneration can be carried to a lower speed.

The subject of line voltage was discussed at considerable length. There is a tendency to adopt higher voltages than the standard 600. In the United States a voltage of 1,200 to 1,500 had become the standard for interurban railways, whilst pressures of 2,400 and 3,000 volts are also being used in one or two instances. A continuous-current voltage of 5,000 has also been employed on an experimental equipment of the Michigan United Traction Co. for the past seven or eight months.

Two conditions of prime importance are necessary to enable equipments to operate interchangeably over different lines, namely :—(1) The contact conductors must be so arranged that any equipment can take power from any line without change. (2) Every equipment must be so designed as to operate at required speeds over the various voltages of the different lines. Various control diagrams were given in the Paper, and it was shown that very great complications are involved in operating over three or four continuous-current voltages with full speed on, say, three of them, and with different forms of contact devices.

In conclusion, the author pointed out the necessity for the early standardisation of some of the more important features connected with electrification, in particular the location of the contact rail for third-rail system, and the voltage. The initiative, he said, should be taken by the Institution. If manufacturers could combine their efforts to the development of apparatus for one or two voltages rather than spreading them thinly over a broad field, and could build enough apparatus of one type to put it on a manufacturing basis, the cost would be greatly reduced, the railways could save a large percentage of the present cost, and the manufacturer could also make a profit.

The author was not present in London, so Mr. J. S. Peck read the Paper for him.

The discussion was opened by Mr. C. H. Merz, who thought it remarkable that regenerative control was not more used, considering the saving that it could effect. He thought that a standard voltage of 600 would be quite acceptable to railwaymen on account of the amount of apparatus for that voltage already in use, but that the time was not ripe for a high-voltage standard, for the latter must depend on whether third-rail or overhead contact should be adopted—a point not yet decided.

Mr. Roger T. Smith referred to his own previous comparison of electric and steam locomotives, and showed some curves relating draw-bar pull and speed for a G.W. steam locomotive and an electric locomotive with field control. The locomotives were designed to give equal draw-bar pulls at a speed of 76 miles per hour, and the curves showed that, in order to obtain this, the electric locomotive had to be designed to give much higher tractive efforts than were necessary at low speeds, and its weight and cost were out of all proportion to its capabilities, its cost being about four times that of the steam locomotive. He also mentioned that the side-contact third rail recently put in on the L. & Y. Rly. had given perfectly satisfactory operation during the recent snowstorms.

Dr. S. P. Smith said that a consideration of Mr. Roger Smith's curves suggested the necessity of turning to alternating-current motors to obtain the required characteristics. A serious obstacle to the adoption of regenerative control was the fact that the rating of motors would have to be reduced, as the time usually allowed for a motor to cool would now be spent in generating more heat.

Mr. Lydall said that one should not lose sight of the fact that an increased voltage means an increased cost of equipment. He had worked out the design of two armatures to run at 1,500 volts, one insulated for 1,500 volts only, and the other insulated for 3,000 volts; the increase in d^2l for the latter case was no less than 40 per cent., owing to the smaller slot space factor and the extra room taken up by the end connections.

Mr. H. M. Sayers said regenerative working implies shunt characteristics on the part of the motor, and there was a possibility that it might in such a case be found advantageous to introduce a mechanical speed-reducing gear.

Mr. H. W. Firth asked whether the author had any sanguine hopes as to the possibility of using regenerative control on multiple-unit equipments, or whether on account of its complexity that system was suggested for use on locomotives only. He emphasised the necessity of railway equipments on all lines being interchangeable. There seemed to be a tendency to regard 600 volts as a standard already fixed, but, he suggested, 1,200 volts might prove more suitable for the lower standard.

Mr. J. S. Peck said that even if opinion was against the immediate adoption of standard voltages, temporary standards might prove better than none at all. Replying to the last speaker, he said regenerative control was quite practicable for multiple-unit equipments.

Military Searchlights in Switzerland.—An interesting article has been published in a Swiss paper describing the searchlights used in Switzerland for military purposes. Mobile or portable ones are used for the most part. In the former case the structure upon which the searchlight is erected is in the nature of a telescopic mast mounted on a sort of gun-carriage, the arrangement being such that the mast can be wound up quickly by means of a winch as soon as the searchlight is to be put into action. If electrical supply from the mains is not available, generating plant consisting of a petrol-electric set is carried on another small lorry. In mountain districts the arrangement is modified so that the generating plant can be carried by two men, and the searchlight itself is also made portable. Searchlights at fixed points are also employed for signalling purposes to issue instructions to aeroplanes and to assist them in landing. For signalling, different coloured front glasses are used on the projectors. The same newspaper quotes from a German technical paper to the effect that a Siemens-Schuckert projector two metres (78 in.) in diameter has been installed on Heligoland; the nominal c.p. of the arc itself is stated to be 75,000, and the c.p. of the beam from the projector 250,000,000 c.p.

The Universal Electrical Directory.—The 1916 edition of the Universal Electrical Directory, published by our contemporary, *The Electrical Review*, has just been issued. The arrangement which has been so useful in recent years of dividing the volume into four sections, viz., British, Colonial and General, Continental, and U.S.A., is again followed, with subdivision into alphabetical and classified sections. Attention is called by the publishers to the obvious difficulty in keeping the Continental section as up to date as in pre-war days, but, notwithstanding this, the familiar Red Book is once more welcome as an essential adjunct to the office.

CONTINUOUS-CURRENT RAILWAY MOTORS

A PAPER by Mr. E. B. Pannell on continuous-current railway motors was read at the Institution of Electrical Engineers in London on March 9th. Motors for railway motor-car operation only were dealt with, locomotive motors being excluded, so that general tendencies in design for a particular standard type of motor could be considered. Economies in design during the last seven years were illustrated by curves giving the total weights of motors of various outputs for designs before 1909 and for present-day designs. These curves show a reduction in weight of motors of 10 to 15 per cent. It was shown that the linear dimensions of such traction motors are strictly limited, about 15 in. being the maximum practical length of core between end plates for a 600-volt motor of 200-kw. rated capacity for the standard rail-gauge of 4 ft. 8½ in. It was shown also how the speed of motors is practically limited to a maximum of 600 r.p.m.

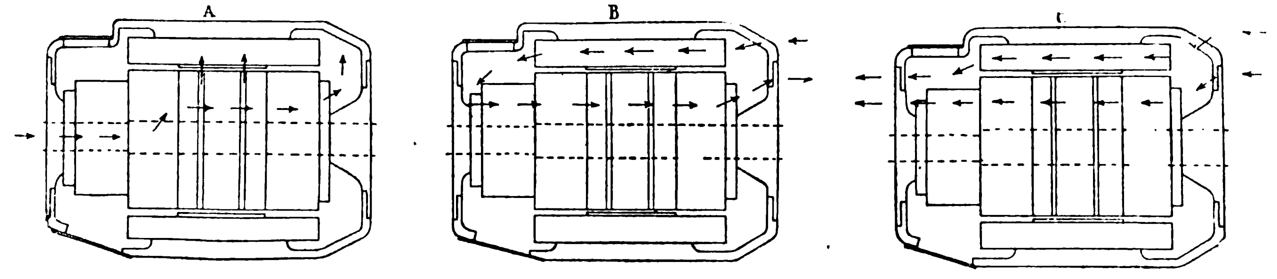
The early difficulties of commutation were discussed, and the author showed that the general introduction of interpoles had resulted in a stronger type of motor, capable of heavier short-time overloads and higher speed and voltage, and with reduced maintenance charges.

Dealing with the advantages of field control, Mr. Pannell said that it is frequently the case that a certain type of motor being standardised by a railway company will be called upon to perform widely different classes of service, possibly interchanging local service with as many as two stops per mile with express schedules running five miles or more without a stop. For the local service, high-speed, low-copper-loss motors are required having a low-speed gear; whilst the most suitable machines for the fast service are those rated at a lower speed and having a low core loss and high-speed gearing. The use of sectional or tapped field control affords one method of effecting the compromise and operating a system of diverse characteristics with one type of motor. More valuable still is the use of field control for notching up on the controller during acceleration. A motor designed for this principle will probably have at its full field a speed 10 per cent. lower than the average machine, whilst with the short field this speed is increased by some 25 per cent. The motor is thus able to run upon either of two speed curves at the will of the motorman.

Sectional field control was used on some of the very early motors, but the method later fell into disuse, and it was not until the general adoption of the commutating pole that field control was definitely established. Without interpoles, as may be imagined, field weakening leads to excessive rushes of armature current, sparking, and flashing over. To a small extent these troubles in earlier motors of the type were due to the shunting of a portion of the field winding rather than to its being open circuited. Such a procedure naturally increased the lag of the field current, opposing the growth of the flux, and serious sparking was the result. The commutating characteristics are so improved in the interpole machine, however, that reduction of the main field by 50 per cent. does not appear to affect the collection of current.

The question of the rating of traction motors on a 1-hour basis was discussed, and the author was of opinion that specifications should call for the value of the various losses at two or three different loads, particularly for the average load at which the motor is expected to operate in service. The basis of both the American and European methods of rating railway motors is the 75° C. temperature rise in a 1-hour run on the test-bed with covers removed and no artificial ventilation. Without having been standardised in England, this system is in very general use here, and might quite well be officially adopted. It is usually recognised that the 1-hour rating represents the maximum desirable current input for acceleration, and that the average load for a complete day's running should not exceed 30 per cent. rated load for unventilated, or 50 per cent. rated load for ventilated, machines. A tendency is at work to assign a standard for continous rating, but in view of the widely different classes and requirements of electric service, and the indiscriminate use of ventilated and unventilated motors, little use could at present be made of this.

Curves were given showing the time taken to attain 75° C. rise on the hottest part of a motor of the ventilated and one of the non-ventilated type, for various loads, expressed as percentages of rated loads, and these showed clearly the great superiority of the ventilated types on loads occurring in practice which are less than the rated load. Illustrations, which we have reproduced, of three methods of ventilation were given. Method A is one of the first in general use in England, and is still in operation on the Central London Railway. These machines had hollow shafts admitting air at the commutator end. The shafts were drilled radially, permitting the air to circulate through longitudinal and radial ducts in the armature core. No definite arrangement for the egress of the air seems to have been provided, however. In more recent designs radial ducts in the core have been quite abandoned in favour of longitudinal passages. The air is admitted, usually at the gear end, transmitted between the poles and over the armature surface to the commutator end, where it flows back through the commutator spider and along the core ducts to the fan, which is fitted at the gear end of the armature core and immediately next the air outlet in the casing. This is known as the series-fan system of ventilation; more recently, multiple fans have been introduced by which the air is all drawn in at one end of the carcase through all the passages in parallel and expelled at the other end. Thus there is no reversal of the air current, its volume and velocity are greater, and there is no risk of sucking in the hot air just expelled from the motor, as is the case with the series fan where the outlet and inlet are necessarily close together. The increased velocity reduces to a minimum the risk of depositing dust or brake-shoe grindings.



In all ventilated motors properly so-called, the air circulation is effected by an exhaust fan of very compact type, usually of aluminium or pressed steel, which is bolted to the armature core and actually forms the end core-plate. The velocity imparted to the air is sufficient to retain in suspension any dust which might enter the casing and to carry it out again. The drawback to the earlier semi-ventilated motor was that no positive velocity was given to the air, and also that the structure of the machines provided dead-ends and pockets into which the dust, grit, iron oxide, and other particles were driven and permitted to accumulate. The present type of motor with its strong induced draught and clean-cut and direct air passages overcomes these drawbacks entirely.

A short discussion of high-voltage motors, and a table of comparative designs for motors at 600, 1,200, and 1,800 volts respectively concluded the Paper.

The discussion was opened by Mr. F. W. Carter (B.T.-H.), who welcomed this Paper as dealing with a subject on which literature is considerably behind development. He was of opinion that too much importance was given in the Paper to the 1-hour rating; that formed the basis of several of the author's curves and tables, whereas it could not actually be relied upon as a criterion of the performance of a motor. It was true the American Institute had included it in their standardisation rules, but he was on the Committee at the time, and he remembered there had been proposals to omit it on account of the undue importance that was likely to be attached to it. The adoption of this basis by the author for the comparison of two particular G.E. motors had produced an erroneous impression of their relative performances. The author's statement that the 1-hour rating represents the maximum desirable current input for acceleration was now no longer true.

With regard to the ventilation of motors, the type shown in Fig. A was of an experimental nature; it had proved inefficient, and was not actually used on the Central London Railway, as stated. Referring to a drawing shown by the author to illustrate the design proposed for a 1,200-volt motor, Mr. Carter

criticised the short bearings, the use of the commutator bush as an oil thrower, and the short seating for the pinion; rectification of these points would show that the 18-in. length of core proposed was impossible in practice.

Finally, Mr. Carter considered that in such cases as railway motors, where physical limitations were naturally imposed on the design, buyers should not make artificial restrictions, such as the specification of a particular 1-hour rating or that a motor must be, say, totally enclosed. Such restrictions often tied the hands of the manufacturer and prevented him from producing as good a motor for the service as he otherwise could.

Dr. S. P. Smith enlarged upon the efficiency and advantages of field control, though the design of many existing motors made them unsuitable for conversion to this form of control. He questioned the wisdom of using such a high voltage per commutator segment as the author had proposed in his design for a 1,800-volt motor—namely, an average value of 20. He also thought the number of slots rather small.

Mr. Lydall questioned the practicability of using field control as proposed to any great extent in traction motors, as it necessitated such a large space in the motor for special connecting leads and joints. He thought the use of diverters was more feasible.

In reply to a question by Mr. Barton as to the use of inductive diverters, Mr. Highfield said he had such diverters in use, and they proved entirely successful.

The reply to the discussion was reserved for a written communication.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

The Telephone and Telephone Exchanges: Their Invention and Development. By J. E. Kingsbury. 588 pp. 9¼ in. by 6 in. 170 figures. (London: Longmans, Green & Co.) 12s. 6d. net; abroad, 13s. 9d.

In this volume Mr. Kingsbury has given us a complete history of the telephone and the development of telephony. He commences with the earliest inventions, and brings the subject right up to present-day practice. The book is what the French would call *très documenté*; so much so, in fact, that it amounts almost to a fault. The many long quotations from depositions, letters, patent specifications, newspaper articles, and speeches would, in a large number of instances, have been far better expressed in Mr. Kingsbury's own words, for Mr. Kingsbury writes well. His collection of records is, however, extremely interesting, and as a book of reference his work is valuable and unique.

Electric Arc Phenomena. By E. Rasch. Translated from the German by K. Tornberg. 194 pp. 8¼ in. by 5¾ in. 52 figures. (London: Constable & Co., Ltd.) 8s. 6d. net; abroad, 9s. 1d.

There are some books which, however thorough they may be and however interested the reader may be in their subject, fail to engross him and awaken no enthusiasm. The book before us is one of these. It is a good review of the subject of electric arc phenomena, and may be regarded in some respects as a summary and completion of the work published by Mrs. Ayrton many years ago, but it is unmistakably dull. This may be because it follows the original German too closely, or it may be owing to its treatment of a subject of intense practical importance almost entirely from the scientific aspect.

The Principles of Dynamo Electric Machinery. By B. F. Bailey. 314 pp. 9¼ in. by 6¼ in., 222 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 12s. 6d. net.

This book is intended to be suitable either as a general textbook for those who do not intend to follow up electrical engineering as a profession, or as an introductory manual for the electrical engineering student. It opens with a brief review of the elementary principles of electricity and magnetism, and proceeds with a descriptive account of the operation of continuous-current motors and generators, and their characteristics, rating, and efficiencies. The theory of alternating currents is then described in an elementary manner, and this is followed by chapters on the application of the theory to the operation of transformers, synchronous alternators, rotary converters, induction motors, and single-phase commutator motors. Chapters on measuring instruments, both A.C. and D.C., are included. The book is intentionally written with the idea of presenting a clear physical conception of the phenomena described, rather than a mathematical treatment of the subject. The danger of learning the mathematics of the subject before a clear understanding of the physical operation is obtained is illustrated by a case which the author mentions. A student at an examination reproduced very well several pages of mathematics relating to transformers, and all would have been well had not a chance question revealed the fact that he believed all the time that transformers operated on *continuous-current* circuits.

An Elementary Manual of Radiotelegraphy and Radiotelephony for Students and Operators. By Prof. J. A. Fleming, F.R.S. 360 pp., 9 in. by 6 in. 194 figures. (London: Longmans, Green & Co.) Third edition. 7s. 6d. net.; abroad, 8s. 2d.

The importance of the subject of "wireless" in connection with naval and military signalling and marine intercommunication generally is, of course, greatly emphasised by the war, and the appearance of a new edition of this elementary treatise on the subject by such an authority as Dr. Fleming is particularly opportune. The book is slightly enlarged, but it remains the same as regards its general features.

Aircraft in Warfare. By F. W. Lanchester, with an Introductory Preface by Maj.-Gen. Sir D. Henderson, K.C.B. 222 pp. 10 in. by 6½ in. 21 figures. (London: Constable & Co., Ltd.) 12s. 6d. net; abroad, 13s. 1d.)

This treatise is a general review of the subject, sufficiently technical to be thoroughly interesting, and not so technical as to make it difficult reading. It is perhaps unnecessary to add that, coming from such an authority as Mr. Lanchester, it is absolutely "sound" in its engineering portions.

Aeroplanes and Airships. By W. E. Dommett. 106 pp. 7¼ in. by 4¾ in. 38 figures. (London: Whittaker & Co.) 1s. net; by post, 1s. 2d.

One cannot expect a 100-page shilling book to deal anything but superficially with so large a subject as this, especially as its contents include also sections on bombs, flechettes, anti-aircraft guns, and searchlights. The general reader will, however, find much to interest him in Mr. Dommett's book, and it is well above the average standard of popular booklets on engineering subjects.

Mechanical Technology. By G. F. Charnack. 635 pp. 8¾ in. by 5¾ in. 503 figures. (London: Constable & Co., Ltd.) 7s. 6d. net; abroad, 8s. 5d.

A treatise, such as this, on the materials and preparatory processes of the mechanical industries, brings together in a convenient way much knowledge that is scattered about and unobtainable at a moment's notice. The book should appeal to the student and apprentice particularly; it consists, in the main, of a recount of experience, at all times a valuable thing to have at command.

Directory of British Manufacturers for Russian Trade, 1915. Edited by R. A. Lenski. 389 pp. 10 in. by 6¼ in. (London: Russo-British Trade Exchange, Ltd.) 5s. net; abroad, 6s.

A good many things have been said as to what we ought to do to stimulate British trade in foreign markets where Germany has hitherto held sway, but this directory is to be welcomed as one of the first practical steps to get outside the atmosphere of discussion. This is the first time, too, in the history of British commerce that an authentic directory of British manufacturers, printed in the Russian language, has been available for the guidance of the Russian buyer. Obviously it is capable of enormous extension, but those firms who have supported it should have little fear as to the results.

Credit, Industry, and the War. Edited by A. W. Kirkaldy. With a preface by W. R. Scott. 268 pp. 8½ in. by 5½ in. (London: Sir Isaac Pitman and Sons, Ltd.) 2s. 6d. net; by post, 2s. 11d.

This volume is a reprint of reports and other matter presented to the Economic Science Section of the British Association at the Manchester meeting, 1915, of which Dr. W. R. Scott was President and Prof. A. W. Kirkaldy, Recorder. These discussions aroused considerable interest, particularly that on "Industrial Harmony," as it was bound to do in such a centre and at such a time. The work constitutes a comprehensive review of our industrial position from all aspects in the light of the consequences of the war so far as we know them, and speculates as to the future with the authority of leading economists.

The Institution Journal.—It was announced by the President at last Thursday's meeting of the Institution of Electrical Engineers that the *Journal* will be published monthly, on the first of each month, until further notice.

B.T.-H. Central Station Switchgear.—The British Thomson-Houston Co., Ltd. (Rugby), have sent us some very fine halftone reproductions of typical A.C. and D.C. switchboards and switchgear installed by them at various central stations. The illustrations are excellent, and the detail is so well brought out that one is able to compare the different features of the various boards. Some of the pictures are of very large boards for private installations, of equal size to those at many supply stations.

11,000-VOLT–0·5 SQ. IN. SUBMARINE CABLES

THE laying of two three-core submarine cables, each over $2\frac{1}{2}$ miles long, 0·5 sq. in. section, and carrying current at 11,000 volts, is described in the *Electrical World* of New York. Recent load increases on the San Francisco distribution system of the Pacific Gas & Electric Co. are now being served by a lately completed high-tension transmission line connecting the Cordelia sub-station 45 miles north of the city with a transformer station on the north shore of the "Golden Gate." At the latter point, energy is stepped down from 60,000 volts to 11,000 volts, and is transmitted to San Francisco distributing points through two submarine cables laid across the Golden Gate during the latter part of last October. The laying of the two cables, each about 13,500 ft. long, presented new problems, because it was necessary to cope with swift tidal currents and a very irregular bottom in deep water. Moreover, there was frequently the danger in the heavy fogs of being fouled by the ships that ply continually in and out through the Golden Gate. Both cables, however, were laid without accident of any kind, and final tests were completed within forty days after the barge left shore with the first power cable.

Each of the power cables consists of three stranded-copper conductors having a net area of 350,000 circular mils. (0·59 sq. in.) at the shore ends, and 250,000 circular mils. (0·5 sq. in.) for the length in deep water. The former is 4·5 in. in diameter, weighing about 22 lb. per foot, while the latter measures 4 in. and weighs 19 lb. per foot. Each conductor has an insulation of 6/32 in., 30 per cent. Para rubber compound, taped with a 1/16-in. layer of varnished cambric and wound with a spiral wrapping over jute insulating compound filler. This wrapping was protected by a 5/32-in. thickness of varnished cloth, over which a 5/32-in. lead sheath was used, and this in turn was covered with a coating of jute and wrapped with forty-two No. 4 B.W.G. extra-galvanised armour wires. Finally, a finished jute coating was put on over the armour. The cables were delivered on the barge in drums containing 1,275 ft. and weighing 15 tons each.

Steel "messenger" cables, each 14,000 ft. in length and $1\frac{3}{8}$ in. in diameter, were laid first. These consist of thirty-seven strands of No. 4 B.W.G. galvanised steel wire woven as cable instead of rope. The breaking strength of the cable is rated at 90 tons. At either shore end this cable was passed around a sheave anchored in concrete. Owing to the swift tidal currents, it was deemed preferable to pay out the power cable from a barge headed into the current instead of across it, and the drums were accordingly mounted across the barge. The barge used was 75 ft. by 30 ft. in plan, with a capacity of 150 tons. The crew consisted of eight men, exclusive of the 40-h.p. petrol launch tender which was used to advance the barge when actually paying out cable. The power cable was made fast to the "messenger" cable by a continuous wrapping of No. 6 steel wire, supplemented at intervals of 20 ft. by a lashing. With this system the maximum drift of the barge off the original course of the messenger cable was not more than 200 ft. From the substation on the north shore megger tests were made continuously, and every few thousand feet, while the joint was being made on the barge, full 22,000-volt tests were made.

Included within the jute filler between the conductors was a twisted pair of No. 13 B. & S. copper telephone wires insulated with 2/32-in. varnished cambric. At the joints these leads were alternated so as to be adjacent to different conductors in each successive length of power cable. At the terminals the telephone leads were brought out of the cable and passed through an insulating transformer. Voice transmission with the telephone line is said to be as satisfactory as over wires strung on the poles of an ordinary transmission line.

Two new features of this method of cable-laying were developed specially for the work in the Golden Gate, namely, the cable guides and the winding engine. The cable guide was designed to allow the cable free motion about the sheave axle at the same time that it prevented any deflection in a horizontal plane which would tend to throw the cable off the sheave as the tension varied with different depths or as the cable was under-run. It consisted of a heavily-constructed timber frame supporting two pairs of guide rollers and carrying idlers for directing the cables. The entire rig was hung on the sheave axle.

An engine-driven winding reel made it possible to put the wrapping on each joint by machine in six hours less time than required by hand operation. The reel consisted of a steel frame carrying a drum through which the power cable could be passed, and which carried two spools of wire. These spools were unwound by the revolution of the drum as fast as the wire was used on the cable wrapping. The drum was driven by a belted connection with a petrol engine. By using this winding device the normal time for completing the power cable joint on the barge was eight hours.

One of the difficulties of the work was the great irregularity in the depth of the water, which ranged up to a maximum of 210 ft. This made it difficult to control the slack in the messenger cable, particularly since this had been laid on a curve in order to take advantage of the most favourable conditions of tidal currents and depths. The maximum tidal flow is rated in Government records as 6 knots per hour, but the work of paying out the cable could not be safely carried on when the tidal currents were at a maximum. By keeping the barge headed into the current, however, the pressure was much less than if it had to be advanced broadside. The final position of the power cable on the bottom is considered entirely satisfactory.

Each cable was laid in sections about 1,275 ft. long, which called for the making of eleven joints aboard the barge. When a length of cable had been paid out, the messenger was made fast in a grip on one side of the barge. To secure sufficient armour to make the required 15-ft. lap for a strong joint, it was necessary to cut off 15 ft. of the cable projecting out of the water. The armour was then folded back and held in place and shape by holding rings for laying back in final position. The copper conductors were sweated together, taped and insulated, and the joint was covered with a single lead sleeve 4·5 in. inside diameter by 5/16 in. thick and 24 in. long. This joint was then filled with "ozite" compound at a temperature of 460° F., sufficient to vulcanise the rubber tape on the conductors. The joint was finally sealed and burlap dipped in hot insulating compound applied over the joint. The armour wires were replaced over the joint by the barge-serving machine already mentioned. Every 12 in. the serving wires were soldered to prevent unwrapping in case of a break. In paying the joint overboard care was taken to protect it from strains. It required about twenty-four hours to pay out one length of 1,275 ft. of cable and make a joint. The speed when laying the cable was about 8 ft. per minute.

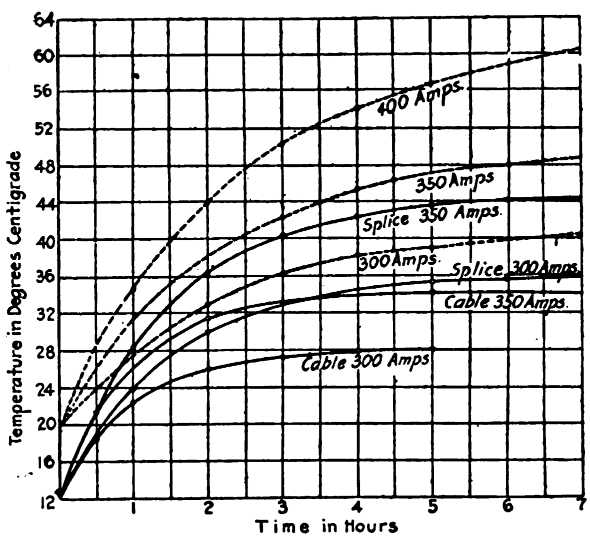


FIG. 1.—TEMPERATURE RISE IN THE CABLES—SOLID CURVES FOR SUBMARINE SECTIONS AND DOTTED CURVES FOR SHORE ENDS.

The submarine cables installed connect with two underground cables on the San Francisco side. It was necessary to use two cables, because the size of duct lines would not accommodate one cable with a rating equivalent to the submarine cable.

Exceptional opportunities were available in connection with this installation for determining heating tests on submarine cables. By means of an available 650-volt, 1,000-kw. D.C. generator it was possible to circulate direct current through the conductors of the submarine cable. The telephone wires in the cable and on the San Francisco shore end were used as pressure wires to determine the voltage drop in the cable for any given load.

From the observations obtained the temperature curves of Fig. 1 were plotted. The solid curves show the rise in temperature of the submarine cable for loads of 300 amp. and

350 amp., the temperature of the bay water being 12° C. As each cable contained several joints, and as the insulation around the joint was much greater than the insulation around the cable, laboratory tests were made on a joint under temperature conditions similar to those surrounding the joint in the water. The rise in temperature for the joint, according to these tests, is also shown in Fig. 1.

From the curves it will be seen that cables immersed in water of 12° C. have a comparatively high carrying capacity. These tests were conducted for a period of twelve hours, which was long enough for the temperature to become steady, although the curves do not show this.

The larger cables at the shore ends are not entirely under water. It was therefore necessary to make the same tests on these cables. The dotted curves show the temperature rise for the shore ends. As the life of the rubber insulation depends largely upon the temperature to which the rubber is subjected, it can therefore be seen that the safe carrying capacity of the cables is approximately 350 amp., owing largely to the radiating capacity of the joints and the large size of the shore ends, although under emergency conditions for very short periods of time the cables could safely carry as much as 400 amp.

The specifications called for a test pressure of 30,000 volts for thirty minutes at 60 cycles per sec. between conductors and between conductors and earth at the factory before leaving. The telephone conductors were required to withstand a pressure of 4,500 volts between conductors and between conductors and earth. On final breakdown test it required 100,000 volts to puncture between conductors of the main cable and 46,000 volts between conductors of the telephone cable.

DESIGN OF A MILLION-VOLT TRANSFORMER

The design of the million-volt 1,000-k.v.a. transformer installed at the Panama-Pacific International Exposition is described in a recent issue of the *Electrical World* by Mr. Guy L. Bayley, the chief engineer of the Exposition. The transformer, of which we have already given a brief description (see Electrical Engineering, Feb. 17th, p. 60), is of the core type, with all the coils mounted on the top section of the rectangular-shaped core. The latter is 16 in. square in section, and has an opening 7 ft. long by 40 in. high. The low-tension coils, of which there are 122, form a cylinder 67 in. long, 23 in. inside diameter, and 28 in. outside diameter. The 190 high-tension coils form a second cylinder 71 in. long, 43 in. inside diameter, and 51 in. outside diameter. The two windings are separated by a paper tube of unusual proportions, being 92 in. long, 6 in. thick, 42 in. outside diameter, and weighing about 2,000 lb. Special interest attaches to this tube, as the winding as well as the impregnating were done in a large steel-plate cylinder under a high vacuum. All the mechanism for winding was installed in this cylinder, and glass openings were provided for observing the process.

The transformer was installed in an open-type concrete tank or pit lined with galvanised iron. The depth of oil over the electrostatic shield was 6 in., and 225 barrels of oil were required. The surface of oil in the tank had an exposure of 288 sq. ft., and some fear was felt that there would be considerable absorption of moisture from the air. Contrary to expectations, the dielectric strength of the oil improved after the transformer had been operated for a short period. Before use the oil tested from 18,000 volts to 20,000 volts with a gap of 0·2 in. between 0·5-in. diameter spheres, but under the electrostatic stress accompanying operation the dielectric strength rapidly rose until on test the oil stood a voltage of 40,000, at which value it remained throughout the period of operation.

An advantage of the open-type construction adopted was that the conductors were all exposed to the oil, and the heat generated in the windings was rapidly transferred to the oil. The arrangement of the coils was such that a rapid circulation of the oil is possible, and under test it was found that the difference in temperature between the windings and the oil at full load was about 3° F., which difference did not appear to increase materially at overloads, owing doubtless to the increased circulation of the oil at the higher temperatures. The transfer of heat to the oil and the circulation of oil around the coils was so perfect that the danger of overheating was eliminated with satisfactory means for cooling the oil.

Death of Lady Kelvin.—The death is announced of Lady Kelvin, the second wife of Lord Kelvin.

MODERNISING A SUPPLY UNDERTAKING

At the Liverpool Engineering Society on March 8th, Mr. E. M. Hollingsworth read some "Notes on the Modernising of an Electric Supply Undertaking," referring in particular to the St. Helens Corporation undertaking. Seven years ago extensions were required, and the opportunity was taken of changing from D.C. to A.C. generators. The plant at that time consisted of four Lancashire and two small water-tube boilers and seven engine-driven 460–550-volt D.C. sets, aggregating 1,700 kw. The capital cost, including buildings but not land, had been £40 per kw. At that time 2,750,000 units were sold per annum, and the load factor was 26·5 per cent. The capacity of the station is now 7,200 kw., of which 6,000 kw. (0·8 power factor) is modern plant installed at a total cost per kw. of £10 17s. 6d.

The present boiler plant consists of four 30′ × 8′ Lancashire boilers (used only for stand-by) in No. 1 house, and four water-tube boilers in No. 2 house, all working at a pressure of 170 lb. per sq. in., superheated to 535° F. The generating plant includes three of the old sets, one rated at 500 kw. and two each at 350 kw., with surface condensers. The added sets are three high-pressure turbines of the impulse type, with velocity wheel, operating with steam at 170 lb. pressure, superheated to 520° F., coupled to 6,000-volt three-phase 50-period alternators running at a speed of 3,000 r.p.m. A 28-in. vacuum is obtained on the condenser.

No. 1 combined set, installed in 1910, has a rated output of 1,250 k.v.a., with a steam consumption of 15·6 lb. per kw.-hour at full load, and 18·5 lb. at half load. No. 2, installed in 1912, has a rated output of 2,500 k.v.a., with a steam consumption of 15·2 lb. at full load, and 17·2 lb. at half load. No. 3 set (just being completed) has a rated output of 3,750 k.v.a., with a guaranteed steam consumption of 13·9 lb. at its most economical output, *i.e.*, 75 per cent. of the rated output of the generator.

Each generator has an exciter mounted on the shaft, and the voltage is controlled by an automatic pressure regulator, that of No. 3 set being also arranged to control the other generators when operating in parallel. Sets 1 and 3 are self-ventilated by means of fans fitted on the shaft at each end of the rotor; No. 2 has an external fan, electrically driven. At present the air is drawn through cloth filters, with the intake outside the station, but a wet filter of the rotary type is being installed.

The replacing of inefficient plant by other of modern type has effected a saving which, while it is less than was anticipated, owing chiefly to the ever-rising price of fuel, is more than sufficient to meet the annual capital charges on both the original and the modern plant, and the output of the latter is sufficient to cope with a very considerable increase in the demand. The total costs *plus* capital charges per unit sold have decreased from 1·5d. in 1908–9 to 1·07d. in 1912–13, with coal at 7s. and 7s. 9d. per ton respectively, and in 1914–15 rose only to 1·12d., in spite of the price of coal having risen to 15s. per ton.

War Tribunals.—Cases in which applications for exemption for men engaged in various capacities in the electrical industry still continue to come before the War Tribunals in various parts of the country. At Batley the Borough Electrical Engineer sought exemption for a clerk employed at the electricity works, but as it came out in the proceedings that he had not the authority of his Committee for making the application, the Mayor, who presided, refused to grant it. An employee of the Sunderland Corporation Electricity Supply Committee claimed exemption on conscientious grounds, but was unsuccessful. In the case of a switchboard attendant in the Cromer Electricity Works, two months' extension was granted. An electrician to a large cotton manufacturing company at Haslingden, on behalf of whom it was stated that he was the only employee left who could look after the motors, was refused exemption.

Siemens' Staff with the Colours.—Messrs. Siemens Bros. & Co., Ltd., Woolwich, have sent us a copy of a booklet containing the names of all their employees, now well over 1,500, serving in His Majesty's Forces, and also a Roll of Honour giving the names of those who have fallen for their country.

Death from Electric Shock.—An inquest was held last week at Deptford concerning the death of an electrical engineer named Monk employed at the Deptford Works of the London Electric Supply Corporation, who met his death from electric shock on the 5th inst. The man was found leaning against a 6,000-volt switch cell with his clothing in flames, and from the evidence it would appear that he had unfortunately gone to work upon the switch without using the switch-testing apparatus which is provided.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of* 10*s. will be paid for the answer which we consider shows the greatest merit, and* 5*s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

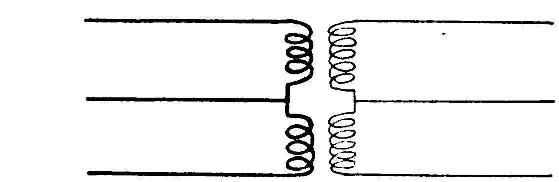
QUESTION No. 1,487.

We have a synchronous motor-generator which we start up from the D.C. side and synchronise by means of a synchroscope. During some recent alterations to the three-phase supply cables on the roof the phases were crossed, with the result that, when we tried to synchronise soon afterwards, the circuit-breaker came out with a terrific kick, though the machines were apparently in synchronism. Is there any method of ascertaining that all is well on the A.C. side, so that this trouble may be avoided in the future?—ATTENDANT.

(*Replies must be received not later than first post, Thursday, March* 30*th.*)

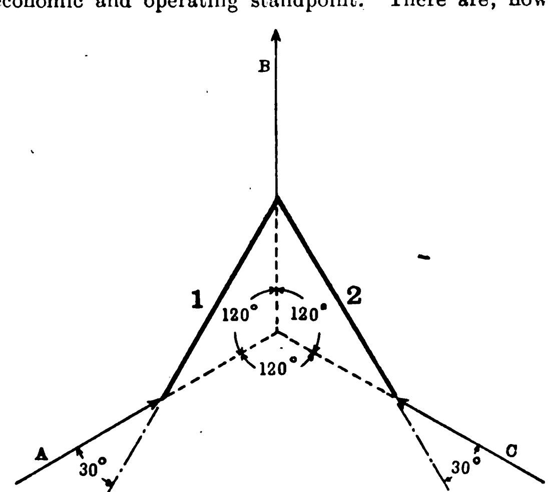
ANSWER TO No. 1,485.

Explain and sketch the curves, &c., of the phenomena that occur which make it possible to take three-phase supply from two single-phase transformers, connected as per sketch.—W. E. L.



The first award (10s.) is made to S. Austen Stigant for the following reply :—

The arrangement shown in "W. E. L.'s" sketch is the familiar "open delta" method of connecting two single-phase transformers for three-phase operation. The connection is one that possesses considerable utility, both from an economic and operating standpoint. There are, however,



certain peculiarities resulting from the "open delta" connection which should be borne in mind, and which may frequently be the deciding factor as to its adoption.

In a bank of three single-phase transformers connected in closed delta the transformer currents and voltages are, assuming unity power factor, in phase, and the kw. equals the k.v.a. capacity. If, however, one transformer is removed, the remaining two either become seriously overloaded or, if their individual load is kept normal, operate at only 57·7 per cent. of the original kw. bank capacity. Also the transformer voltages and currents are not in phase, and the k.v.a. is greater than the kw. capacity.

A brief mathematical investigation, together with a concrete example, will perhaps better explain the conditions :—

Consider first three single-phase transformers in closed delta, each 50 k.v.a., 5,000 volts H.T., operating at unity power-factor. The line current is equal to :—

$$\frac{K.v.a.\text{ per transf.}\times 1000\times\sqrt{3}}{\text{line voltage}}=\frac{50\times 1000\times 1{\cdot}73}{5000}=17{\cdot}3\text{ amps.}\ldots\ldots \quad (1)$$

$$\text{while the current in each transformer}=\frac{50\times 1000}{5000}=10\text{ amps}\ldots\ldots \quad (2)$$

The total capacity of the bank equals :—

$$\frac{\text{Line voltage}\times\text{line current}\times 3}{\sqrt{3}\times 1000}=\frac{5000\times 17{\cdot}3\times 3}{1{\cdot}73\times 1000}=150\ K.v.a.\ \ldots\ldots \quad (3)$$

The angular distance between the line current and transformer phase currents equals :—

$$\cos^{-1}\frac{\text{line current}}{2\times\text{trans. current}}=\cos^{-1}\frac{17{\cdot}3}{20}=\cos^{-1}0{\cdot}866=30^\circ\ \ldots\ldots\ldots\ldots \quad (4)$$

From this it will be seen that the transformer currents and voltages are in phase, that each transformer takes its full normal load, and that the entire bank maintains its 100 per cent. capacity.

Now remove one of the transformers, thereby converting to an "open delta" bank. The figure below shows vectorially the modified conditions. *A*, *B*, and *C* are the line currents, which we will first assume are kept constant. Dealing with line *A* as an example, it will be seen that the line current on reaching transformer 1 has one path only in which to flow, and no alternative as with a closed delta. Therefore the line current in *A* must flow in transformer 1 with its full value and phase relation—*i.e.*, the current in transformer 1 will be 17·3 amps., and, as found from equation (4), will be 30° out of phase with the transformer voltage. Transformer 2 is similarly affected, so that each transformer will be overloaded to the extent of approximately 73 per cent., and will also be operating at $\cos 30^\circ = 86{\cdot}6$ per cent. power factor. But where one transformer takes a lagging power-factor, the other takes a corresponding leading power-factor.

If the load on the open delta bank is reduced to meet the modified conditions, and to such an extent that normal rating current flows in each transformer, then the kw. capacity of each transformer will equal $50\times 0{\cdot}866=43{\cdot}3$. The kw. capacity of the bank will equal $2\times 43{\cdot}3=86{\cdot}6$ as against 150 kw. of the closed delta bank. Therefore the power supplied by the open delta bank under normal rating will only be $\frac{86{\cdot}6\times 100}{150}=57{\cdot}7$ per cent. of that supplied by a closed delta bank of three transformers of the same capacity.

The following shows concisely the capability of the open delta arrangement as compared with three delta-connected transformers :—

Relative Capacities to Supply Same Total Power.

K.v.a. capacity of each transformer, 173 per cent.
Ditto of group, 115·5 per cent.
Kw. capacity of each transformer, 150 per cent.
Ditto of group, 100 per cent.

Transformers of the same k.v.a. Rating.

K.v.a. capacity of each transformer, 100 per cent.
Ditto of group, 86·6 per cent.
Kw. capacity of each transformer, 86·6 per cent.
Ditto of group, 57·7 per cent.

The power-factor obtained will be 86·6 per cent. in all cases. (It has been assumed throughout that the load is non-inductive, and that all the transformers have the same characteristics.)

No second award is made.

ANSWER TO QUESTION No. 1,482.

In Answers to Correspondents last week, we referred to a numerical mistake made by L. R. in his reply. Presumably he intends to use a value of B=13,000 in his calculation for the no-volt release coil. Messrs. Cramp & Frith point out further that he should not have used, without explanation, a formula for calculating *L* only applicable to a coil without iron, especially as he had already used the flux to obtain the coil dimensions.

ANSWERS TO CORRESPONDENTS

E. GODDARD.—The question you suggest is hardly suitable for competitive replies, as it is fully dealt with in text-books. See, for instance, "The Design of A.C. Machinery," by Barr and Archibald, a copy of which we can supply you with at the net published price (12s. 6d.).

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published March 16th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

3,763/15. **Distribution Boards.** J. H. TUCKER and J. A. CRABTREE. A distribution board with the fuses mounted upon a fuse-holder or handle, and with a protecting cover so arranged that while the fuse-holders project sufficiently to be readily accessible, but do not occupy a position further forward than the cover, and can be removed without taking off the cover. (Two figures.)

5,002/15. **Voltage Regulator.** IGRANIC ELECTRIC CO. (*Cutler-Hammer Electric Co.*). An automatic regulator for car-lighting circuits and other purposes designed to adjust the output of a generator to that required to charge the battery when there is no current consumption and to vary the standard of regulation and reduce the voltage when there is current consumption, of the type involving a vibrating relay energised by a shunt circuit and controlled by electro-magnetic means in response to the conditions of the circuit. In this form of the apparatus a resistance is inserted in the shunt circuit of the relay, and not in series with the lamps, and the load switches are so arranged that the closing of any one of them short-circuits the resistance in the shunt circuit. (Five figures.)

7,269/15. **Cable Calculator.** W. D. REID and CALLENDER'S CABLE AND CONSTRUCTION CO. A slide rule for reading off the current and voltage for transmission of any horse-power D.C. or A.C. at any power factor, and the correct size of cable to use for any distance and permissible voltage drop.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

(*Numbers in brackets refer to the new system of numbering.*)

Switchgear, Fuses, and Fittings: EICKMANN [Plugs and sockets] 8,349/14; WALLER [Switchgear] 3,490/14; GROVES and BRITTAIN [Circuit breakers] 3,500/14; HOLT [Distribution boxes] 3,505/14; SMITH [Liquid-operated switches] 17,412/14.

Telephony and Telegraphy: DIXON [Telegraph systems] 23,380/14; T. B. DIXON [Telegraph repeaters] 2,028/16 (*100,074*).

Traction: BOUMAN [Signalling] 4,757/15; DUCA, NALDINI, MASSAVELLI and BELLONE [Car-lighting and engine-starting apparatus] 4,895/15; SCOTT [Conductor rail insulator clip] 7,498/15.

Miscellaneous: SCOTT and WHEATLEY [Mine shaft signalling apparatus] 3,393/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Electric welding] 9,628/15; F. KRUPP A.G. GRUSONWERK [Magnetic separators] 489/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Telegraphy: C. A. W. HULTMAN [Automatic telephones] 2,660/16.

Miscellaneous: S. DUSHMAN [Discharge devices] 2,328/16.

Opposition to Grant of Patents

The grant of patents on the following applications has been allowed in spite of opposition:—

17,133/14. **Electro-deposition.** T. R. HARRIS. A process of electro-deposition of metals on revolving cylinders using a high-current density.

18,443/14. **Railway Signalling.** H. A. THOMPSON. A system of track circuit signalling with automatic train stop apparatus depending on vibrating reed relays.

Expired Patents

The following are the more important patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: BRITISH INSULATED & HELSBY CABLES, LTD. [Tinning conductors for cables] 26,787/07.

Dynamos, Motors and Transformers: H. A. MAVOR and MAVOR & COULSON [Brush holders] 25,990/03.

Switchgear, Fuses and Fittings: R. F. S. VENNER and R. C. GRIESBACH [Time switches] 24,931/05; W. P. HAMLYN [Circuit breakers] 27,358/06; B.T.-H. Co. and W. P. HAMLYN [Circuit breakers] 17,475/07; B.T.-H. Co. and A. P. YOUNG [Voltage regulators] 27,827/09

Traction: C. DE KANDO [Overhead contact lines] 26,476/02.

Miscellaneous: E. N. BRAY, F. R. MARKHAM, F. E. REISS and BRAY, MARKHAM & REISS [Enamel insulated resistance coils] 26,706/02.

Tasmanian Hydro-Electric Scheme.—According to His Majesty's Trade Commissioner for Australia, the Hydro-Electric Scheme of the Tasmanian Government has in view the utilisation of water-power derived from the Great Lake, and its conversion into electrical power for distribution at Hobart and throughout the Island. It is expected that at least 26,000 actual h.p. at the turbine shafts could be generated for twelve hours per day, or 39,000 actual h.p. for eight hours per day, and it is believed that this could be increased eventually to 70,000 h.p. Owing to the difficulty in obtaining delivery of certain parts of the machinery the completion of the installation (which has cost about £350,000) has been delayed, but it is expected that the work will be completed this month (March), or early in April. In order to bring the scheme to the notice of Australian manufacturers and others desirous of taking power and light under the scheme, the Government is carrying out a publicity campaign and has, it is believed, made arrangements for the sale of about 9,000 h.p. Works for the manufacture of carbide of calcium were projected, and apparently United Kingdom interests are investigating the possibility of installing woollen mills.

Electric Light Cheaper than Paraffin Lamps.—In Switzerland paraffin has become scarce and dear, and the result has been an enormous increase in electric light. In order to encourage this, or rather mainly in order to alleviate the burden of the higher cost and at the same time to economise the paraffin supplies, public electric lighting undertakings have been carrying out wiring on a hire-purchase system with very modest monthly payments. This has resulted in an enormous increase in connections. In Basle, for instance, 1,600 consumers have taken advantage of the offer in the past six months, and these are mostly four-room houses, with an average of four lamps. Figures have been published in several Swiss newspapers comparing the cost of paraffin, lamp chimney, and wicks for 800 hours' use of a 25 c.p. oil-lamp, on the one hand, with that of current, a lamp renewal, and meter rent on the other, and, even at normal prices for paraffin, electric light comes out much cheaper—at present prices the saving is enormous.

The Airgraph.—Messrs. Davidson and Co., Ltd., makers of the well-known "Sirocco" fans, have sent us a specimen of an interesting device for indicating the distance of aircraft when altitude and angle are known, or, conversely, to indicate the altitude when the distance and angle are known. It consists of two circular carboard discs, one sliding on the other, and is very easy to manipulate quickly. We understand that Messrs. Davidson will be pleased to send one of these "airgraphs" to anybody who is interested on application to their London office, Egypt House, New Broad Street, E.C.

High-Speed Steel Scrap.—The Ministry of Munitions has made arrangements whereby makers of high-speed steel will take back all scrap, short ends, &c., at 5d. per lb. for turnings, and 6d. per lb. for bar ends delivered at steel-makers' works. Under the Defence of the Realm Regulations it is illegal to dispose of high-speed steel through any but authorised channels, and users are advised that the above arrangement should be carried out in every case, and, if possible, with the manufacturer who supplied the original steel.

The Institution, Western Section.—The annual meeting of the Western Section of the Institution of Electrical Engineers will be held on Monday, April 3rd, at 5 p.m., at the Merchant Venturers' Technical College, Bristol, when a Paper on "The Hire and Maintenance of Direct-Current Motors," will be read by Mr. H. Joseph. At 7 p.m. a dinner will be held at St. Stephen's Restaurant.

LIGHTNING

An article on the subject of "Lightning: Its Risks and How to Avoid Them," by Prof. Elihu Thomson, in collaboration with Prof C. A. Adams, Dr. Louis Bell, Prof. D. C. Jackson, and Prof. A. E. Kennelly, appears in the current issue of the *General Electric Review*. In spite of the authoritative names attached to it, the article is very elementary in character, and is intended for the layman.

Thunder, it is explained, is due to the sudden and violent expansion, caused by heating of the air in the path of the discharge. An observer can tell how far he is from a lightning flash by counting the seconds which elapse between his seeing the flash and hearing the definite report, and then allowing about 5 seconds to the mile. Seven classes of lightning are cited :—

(1) *The "Direct Stroke."*—A huge electric spark, occurring either between cloud masses, or between a cloud and the earth. It usually takes a zigzag course, and may be either forked or multiple.

(2) *Band Lightning.*—This stroke is often so broad as to resemble a ribbon or band, and is caused by a rapid succession of discharges along the path, which has meanwhile been slightly displaced by the wind. Occasionally, there seems to be no displacement of the discharge path; but a succession of violent discharges occur in it. This constitutes the multiple or repetitive stroke.

Both (1) and (2) are manifestly dangerous forms.

(3) *Sheet Lightning.*—Due to flashes in or between clouds, or between a cloud and earth, where the direct stroke is itself invisible, but lights up the clouds.

(4) *Heat Lightning.*—A form of sheet lightning, in which the storm is so distant that neither the direct stroke nor the accompanying thunder are observable. Heat lightning is so called because of its prevalence on summer evenings.

No danger need be apprehended from either (3) or (4).

(5) *Ball or Globular Lightning.*—There are numerous records to the effect that a very rare and perhaps dangerous form exists, described by some observers as a luminous but not very brilliant ball or patch, which may persist for some little time, and may move from place to place. It is described as terminating, in many cases, in a loud explosion. No doubt many cases of reported ball lightning are either fictitious or illusory. Nothing is known of its nature or of the dangers, if any, accompanying it.

(6) *Bead Lightning* is another very rare form of discharge described as resembling a chain of luminous beads, gradually fading away. Nothing seems to be known as to the danger, if any, connected with it.

In stating some simple precautions to be observed, the authors observe that many of the persons have been struck in open fields, especially on hills or slopes, towards which a thunderstorm was approaching. Even on flat ground without trees, a man walking or ploughing may cause the lightning to discharge through his body as the shortest conducting path to earth. Groups of men or of livestock in the open are yet more likely to receive a stroke. The safest procedure under such conditions is to seek a dry depression in the ground, and to crouch down in it. Groups should scatter. In an open boat it is safest to crouch down during the height of the storm. Wooden masts should be protected by lightning rods. Steel masts and smoke-stacks need no protection when in a steel-hulled boat, but in a wooden boat should be connected to the sea by chains. The hold of a metallic boat is a safe place, and a person is perfectly safe under the steel deck of a steamer's steel hull.

It is unsafe to take refuge directly under a tree. The person's body may divert a portion of the discharge, or a limb of the tree may be shattered and fall upon him; or, further, the tree trunk may be disrupted explosively, with numerous and heavy splinters projected violently outwards. Yet if no safe situation can be found in the open fields surrounding trees, it is better to take up a position near a tree, avoiding the tallest, but not under its foliage. This exposes the person to rain, but removes some of the danger. The tree may act somewhat like a lightning rod to the space in its immediate vicinity, and, moreover, a man in thoroughly wet clothes is less likely to be injured if he receives a partial discharge. Forest lands are always safer than open fields during a heavy thunderstorm, and if there are small open spaces between the trees, it is safer to select such a position. The safest and most comfortable place of all is at home.

Perhaps we should add that thunderstorms in America are far more violent than in this country, where the number of casualties is extremely small, and the only positions of danger worth considering are in an open field or under a tall tree.

The following advice is given in the article on the construction of lightning conductors. These may be constructed either of galvanised iron or of copper. Iron is the cheaper metal, but it more subject to corrosion. It therefore has to be used in larger sizes, and kept painted if possible, especially at the ground line. Wire, either solid or stranded, piping, or strips may be used. A galvanised iron wire cable $\frac{3}{8}$ in. (1 cm.) in diameter over all is adequate; or small iron standard gas piping of $\frac{3}{8}$ in. (1 cm.) size (internal diameter) will serve, with the ordinary screw couplings well tightened, and the whole painted. Strap iron of equivalent section, using double-riveted joints, and well painted, may also be employed. Insulators to support the rod away from the building are probably unnecessary, and the rod may be conveniently carried down the walls. On the other hand, it its inadvisable to use long spikes for fastening the rod into wooden walls. Screws, being shorter, are preferable.

Metallic roofs, gutters, or water conductors should always be connected to the lightning-rod, either by direct clamping or by strips. Unless the building to be protected covers much ground, a single rod is sufficient. A long building would advantageously be provided with a rod at each end. Long L's or wings of the same height should have similar protection. The upper extremity of a rod should project about a yard (1 metre) above the highest portion of the building, such as a chimney, and for this purpose should consist of a stiff rod, well secured. It may be roughly pointed, but special points of precious metal are altogether unnecessary.

If copper is used instead of iron, on account of its lesser liability to corrosion, and consequent durability, wire or strap copper may be employed, preferably hard rolled. The hard drawn copper wire used for overhead trolley conductor and known as size No. 1 American wire gauge, diameter 0·289 in. (0·735 cm.) (cross-section 0·0657 sq. in. or 0·424 sq. cm.) is excellent. Copper strap of equivalent cross-section may also be conveniently used. Connections between lengths of copper wire or strap should preferably be made permanent by either twisting and soldering or riveting and soldering, and the supports may be the same as for iron conductors. If a house is provided with one or more iron ventilating pipes, having metallic joints, from sewer to roof, no separate lightning-rod is ordinarily needed, but a rod connection is then especially desirable from the top of the ventilating pipe to the nearest tall chimney, so as to project 2 ft. or 3 ft. above it.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"Questions and Solutions in Telegraphy and Telephony: Final Examinations." Compiled by H. P. Few. 74 pp. $7\frac{1}{4}$ in. by 5 in. 21 figures. (London: S. Rentell & Co., Ltd.) 1s. 6d. net; by post, 1s. $7\frac{1}{2}$d.

"Employers and Workmen: A Handbook Explanatory of their Duties and Responsibilities under the Munitions of War Acts, 1915 and 1916." By T. A. Fyfe. 95 pp. 9 in. by $5\frac{3}{4}$ in. (London: William Hodge & Co.) 2s. 6d. net; by post, 2s. 8d.

"A Text-Book of Practical Physics." By H. S. Allen and H. Moore. 622 pp. 8 in. by $5\frac{1}{2}$ in. 297 figures. (London: Macmillan & Co., Ltd.) 8s. 6d. net; abroad, 9s. 4d.

A "Thermo-Electric" Flying Machine.—Mr. W. P. Durtnall has sent us a communication with regard to an invention which he calls the "Paragon Thermo-Electric Flying Machine." He refers first to some experiments made by him with boats on the Thames about four years ago. These boats were not fitted with the ordinary screw type of propeller, they had no rudder or reversing gear; they could, however, run either "ahead," "astern," or turn on their own centres, and without either reversing the engines or the propellers; and from scientific tests made, and after many experiments, Mr. Durtnall claims to have proved that the propulsive efficiency, or thrust pressure produced per unit power, was higher than with a screw propeller. The propeller was actually in the form of a feathering paddle-wheel submerged completely at the after end of the keel of the boats. The driving power was electricity, generated by machines driven by internal combustion engines with constant compression pressure. Mr. Durtnall proposes to employ a similar system for driving aircraft. "Just the same way in which the marine propellers were designed to produce thrust to overcome the skin resistance of the boats," he says, "so will the aerial propellers be designed for the overcoming of the attraction of gravity-pull, which would be the chief resistance to be operated against, as the work of propulsion would be very easily carried out after the machine was up, by the fact that the direction of the air stream-lines can be changed in any direction round a centre, in this system of thrust manufacture from the weight and inertia of the air."

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Rathmines.—The Council require twelve months' supply of service cable, house service and fuse boxes and meters. Borough Electrical Engineer. March 27th.

Wiring

Manchester.—Electric light installation at the Nurses' Home, Withington Institution, for the Guardians. Architect; F. A. Overmann, 49 King Street. March 29th.

Miscellaneous

Edinburgh.—Twelve months' supply of electrical stores for the Dewar Place power station. Town Clerk. April 1st.

Lancashire & Yorkshire Rly.—Twelve months' supply of signal, telegraph, and electric fittings and wires. Secretary, Hunt's Bank, Manchester. March 30th.

Liverpool.—The Toxteth Park Guardians require three months' supply of electrical sundries. Clerk, 15 High Park Street, Liverpool. March 27th.

Midlothian.—The Midlothian & Peebles District Asylum require six months' supply of electric fittings. Clerk, 19 Heriot Row, Edinburgh. April 3rd.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, of 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £135 to £137 (last week the same).

Trade in Tasmania.—It is anticipated that there will be a large demand for electrical fittings and appliances consequent on the development of the Government hydro-electric power scheme, of which particulars are given on another page. In this connection the Imperial Trade Correspondent at Hobart is willing to assist British firms to secure the services of reliable firms in Tasmania who would be ready to act as agents. Communications should be addressed to A. H. Ashbolt, 23 Old Wharf, Hobart, Tasmania.

APPOINTMENTS AND PERSONAL NOTES

The salary of Mr. W. J. U. Sowter, Borough Electrical Engineer at Bray, is to be increased by £40 per annum.

The Fulham Electricity Department requires a Junior Engineer. (See an advertisement on another page.)

LOCAL NOTES

Ashton-under-Lyne: *Increased Charges.*—It has been decided to increase the electricity tariff as follows:—25 per cent. on tramway supply, 10 per cent. on private consumers, and 25 per cent. to all direct-current consumers.

Bradford: *New Plant.*—In consequence of the rate of increase and the demand upon the electricity undertaking, the Electric Supply Committee has accepted offers for additional plant, consisting of boilers and economisers, at a cost of £23,500. Last year the maximum demand was 15,000 kilowatts, but during next winter the signs are that these will increase from 20,000 to 25,000 kilowatts. The capacity of the generating plant, however, is able to cope with the demand, the deficiency being in boilers. The tender has been accepted in anticipation of the Treasury consent, but it is not anticipated that there will be any trouble on this score.

Harrogate: *Supply to Ripon.*—The Ripon Council recently asked Harrogate the terms upon which it would supply electricity in bulk. The Harrogate Corporation has now replied that, having regard to the necessary capital expenditure involved and the limited supply required by Ripon, it is unable to entertain this proposal.

London: *Charing Cross Co.*—The Charing Cross, West End & City Electricity Supply Co. is applying to the Board of Trade for permission to increase the maximum prices in its City Electric Lighting Order from 5d. to 5½d. per unit during the period of the war and for twelve months afterwards. The Streets Committee of the City Corporation recommended that no objection be offered to this, but when the matter came before the Corporation the Committee's report was not adopted.

Luton: *Coal Contracts.*—The Electricity Committee has been having a controversy with the Ibstock Collieries, Ltd., with regard to the coal supply on the ground that the Company had infringed the Price of Coal (Limitation) Act, 1915. At one time there appeared to be a possibility of legal proceedings, but it appears now that the Company admits an error has been made, and will credit the Corporation with the amount overcharged. The saving is estimated at about £675.

Southampton: *Electricity Charges.*—The Electricity Committee recommend an increase in charges for lighting, power, and heat by 10 per cent. as from the midsummer meter readings.

Swansea: *Tramway Supply.*—A scheme is being prepared by which the Electric Lighting Committee will supply the whole of the needs of the Tramway Company's undertaking in future instead of, as hitherto, only a part. As the Tramway Company has its own power station, the scheme will involve the shutting down of it.

Yarmouth: *Electricity Deficit.*—It has been reported that the Electricity Committee will have a deficiency of £6,000 for the year ending March 31st, notwithstanding that the charges have been increased.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Newcastle-on-Tyne Electric Supply Co.—A final dividend, making 6 per cent., is declared for 1915 upon the ordinary shares. This maintains the steady increase of a ½ per cent. per annum which has been paid since 1908, when the rate fell from 8 per cent. to 2½ per cent.

Newcastle & District Electric Lighting Co.—After meeting the debenture and loan interest, and taking into account the carry forward from 1914, there was a net profit of £49,056 for 1915. Although this is an increase over 1914, no dividend is recommended upon the ordinary shares in consequence of the abnormal conditions.

Bruce Peebles.—There is a nett profit of £7,096 in 1915, which is carried forward. During the whole year the works were entirely employed on war work.

At the annual meeting in Edinburgh the Chairman remarked that, although there was a popular idea that all Government orders carried an excessive amount of profit, this was certainly not so in their case. The margin of profit upon which the work had been accepted from the Government was a moderate one.

Brompton & Kensington Electricity Supply Co.—This is the last of the London Supply Companies to issue its accounts for 1915. From them it is seen that a 10 per cent. dividend, the same as last year, and, indeed, the last thirteen years, is paid. About £10,000 are allocated to depreciation and reserve accounts, slightly less than in 1914, and £6,000 are carried forward.

British Electric Transformer Co.—At the annual meeting last week the chairman, Mr. A. F. Berry, explained that it was in pursuance of the decision to adopt a conservative policy that only about one-half the profits for last year were being distributed in dividends. With regard to "Tricity" cookers, which were looked upon by some people as an economy and by others as a luxury, improved designs were being got out for new articles for which it was believed there would be a good demand. Incidentally, he mentioned with regard to the interest taken by British bankers in these industries, that this Company had always found their bankers willing to support them in cases of necessity.

County of Durham Electrical Power Distribution Co.—A dividend of 3 per cent., less tax, is declared on the Ordinary shares, after placing £6,000 to depreciation.

W. T. Glover & Co.—A dividend at the rate of 5 per cent. per annum is recommended on the Ordinary shares, and after transferring £20,000 to reserve, £11,700 are carried forward.

British Westinghouse Co.—A dividend of 7½ per cent. is to be paid on the Preference shares for 1915.

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SUMMARY

MR. C. P. SPARKS has been nominated for a second year's presidency of the Institution of Electrical Engineers. The Council has also issued their nominations for the annual filling of vacancies (p. 112).

THE invitation to Corporate Members for a postal expression of their opinion on the question of the alien enemy members of the Institution of Electrical Engineers has now been sent out (p. 112).

THE effect of the war is strikingly reflected in the amount subscribed to the Electrical Trades Benevolent Institution in 1915, the revenue amounting to only £886, compared with £3,139 10s. in 1914 (p. 112).

ELECTRICITY works in Germany are experiencing serious difficulties owing to the shortage of oil, this affecting particularly Diesel engine plants and those reciprocating plants using superheated steam. The larger works are less handicapped by the war conditions (p. 113).

WE give the list of electrical and allied firms which have been wound up under the Trading with the Enemy (Amendment) Act, 1916 (p. 113).

OUR "Questions and Answers" page this week deals with the uneven driving of two induction motors which are geared to a common countershaft (p. 114).

SOME extremely long-period contracts made with German telephone manufacturers have been declared void (p. 115).

WE review the work of the British Association Committee which is dealing with fuel economy, and report some suggestions by Sir Richard Redmayne, H.M. Chief Inspector of Mines, with regard to large electric power schemes (p. 115).

SOME interesting information is given in the Postmaster-General's annual report as to the assistance which the Department has rendered to the naval and military authorities in the matter of signalling apparatus. The shortage of skilled operators has brought about an increased use of "phantom" telegraph circuits, and the substitution of the telephone for Morse sounders (p. 115).

AMONG the subjects of specifications published at the Patent Office last Thursday were plug connectors, conductor-rail anchors, and electric welding. A telephone patent has been opposed, a patent for lock-out switches has been granted in spite of opposition, and an appeal has been lodged against the Comptroller's decision to grant a patent for a process of electro-deposition in spite of opposition. Patents connected with railway signalling and electro-deposition expire this week after a full life of fourteen years (p. 117).

THE Birmingham Electric Supply Department is endeavouring to rearrange those power contracts which do not contain the coal clause.—An employé at the Belfast electricity works has been awarded £500 damages against the City Electrical Engineer for "slander" (p. 118).

ADDITIONAL power plant is required at Accrington, Barnes, and Edinburgh, and stores at Bray and Kirkcaldy. A large number of flame arc lamp carbons are required in Australia (p. 118).

AT the annual meeting of the Metropolitan Electric Supply Co., the Board agreed to the appointment of a Shareholders' Committee of Investigation. The recent resignations from the Board were due to differences of opinion as to policy in dealing with power supply. Mr. J. S. Highfield, the Chief Engineer and Manager, also resigned on this account (p. 118).

Arrangements for the Week.—*Saturday, April 1st.*—Association of Mining Electrical Engineers. Notts and Derbyshire Branch. University College, Nottingham. "Bearings of Electrical Machinery," by Andrew Gibson. 3.30 p.m.

Monday, April 3rd.—Institution of Electrical Engineers, Western Section. Merchant Venturers' Technical College. "Hire and Maintenance of Continuous-current Motors," by H. Joseph. 5.30 p.m.

Tuesday, April 4th.—Institution of Electrical Engineers, Manchester Section. Annual General Meeting at Engineers' Club, followed by lecture on "Recent Researches on X-Rays," by Sir E. Rutherford, F.R.S.

Tuesday, April 4th.—Association of Supervising Electricians at St. Bride's Institute, Fleet Street, E.C. "Alternating-current Motors," by H. C. Jacoby. 7.15 p.m.

ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEERS CORPS

COMPANY ORDERS BY LIEUT.-COL. C. B. CLAY, V.D.
Drills, 6.25 to 7.25 : 7.25 to 8.25 p.m.

Thurs., Mar. 30th: Shooting for Sections III. & IV.
Fri., Mar. 31st: Sections III. and IV., technical. Sections I. & II., squad. and platoon. Signalling class and recruits.
Sat., Apr. 1st: Adjutant's instruction class at 2.30 p.m.
Mon., Apr. 3rd: Sections I. & II., technical. Sections III. & IV., squad. and platoon. Signalling class and recruits.
Tues., Apr. 4th: School of arms, 6.0 to 7.0 p.m.

A Board of Scientific Societies.—At the Royal Society on Friday a conference of engineering and scientific institutions was held to consider the desirability of establishing a Board of Scientific Societies to organise scientific effort in this country. The Institution of Electrical Engineers was represented. A Committee was appointed to give effect to the following resolutions and report to a future meeting: "This meeting considers that it is desirable to establish a Conjoint Board of Scientific Societies for the purpose of—(1) Promoting the co-operation of those interested in pure or applied science; (2) supplying a means by which the scientific opinion of the country may, on matters relating to science, industry, and education, find effective expression; (3) taking such action as may be necessary to promote the application of science to our industries and to the service of the nation; (4) discussing scientific questions in which international co-operation seems advisable.

War Tribunals.—Before the Kingston Tribunal last week Mr. J. E. Edgcome, the Borough Electrical Engineer, applied for exemption for a number of his staff whom he regards as indispensable. They include switchboard operators, the chief fitter, skilled labourers, the chief inspector responsible for the maintenance of supplies, a driver of the Diesel engine plant, and others. It was explained that the whole of the electricity works' staff were badged by the Admiralty many months ago, and since then the men had received badges and certificates from the Ministry of Munitions. The fact that the men were badged practically compelled the Tribunal to grant conditional exemption, and this was done in the case of eight men, whilst the ninth man became over age a fortnight ago. The chief assistant electrical salesman of the Ediswan Company in Nottingham claimed exemption last week on the ground that he had received a badge. The Tribunal held that the issue of the badge was not justified by the work done by the applicant, but granted him six weeks' exemption on personal grounds.

THE INSTITUTION COUNCIL

THE nominations by the Council of the Institution of Electrical Engineers for the new Council for 1916–17 have been issued.

Mr. C. P. Sparks has been nominated President for another year, and the Council could hardly have come to a more welcome decision. He is one of the most popular Presidents we have had, and has done good work during a difficult year of office. Mr. Sparks is Engineer-in-Chief to the County of London Electric Supply Co., and has, in addition, an important consulting practice.

MR. C. P. SPARKS.

Mr. J. S. Highfield, Consulting Engineer to the Metropolitan Electric Supply Co., Ltd., is nominated for re-election as Vice-President; and **Mr. R. A. Chattock,** City Electrical Engineer, Birmingham, is nominated as a new Vice-President to fill the vacancy caused by the retirement of Mr. C. H. Wordingham by rotation in the ordinary course. Dr. Alexander Russell and Mr. Roger T. Smith remain as Vice-Presidents.

The re-election of **Mr. J. E. Kingsbury** as Hon. Treasurer will follow as a matter of course. Mr. Kingsbury, who is a Director of the Anglo-Portuguese Telephone Co. and the Western Electric Co., was selected by the Council to fill the vacancy on Mr. Robert Hammond's death last August.

There are two vacancies for Ordinary Members of Council due to the retirement of Mr. R. A. Chattock (who, as already stated, has been nominated Vice-President) and Professor B. Hopkinson by rotation. Four names are put forward by the Council: **Charles Bright,** F.R.S.E. (Consulting Engineer), **F. Gill** (Consulting Engineer), **G. H. Nisbett** (Engineer and Manager of the British Insulated & Helsby Cables), and **W. Ll. Preece** (Consulting Engineer). In addition, the following members will continue as Ordinary Members of Council:—W. A. Chamen, J. Christie, H. Dickinson, Professor T. Mather, F.R.S., G. W. Partridge, W. H. Patchell, G. S. Ram, R. J. Wallis-Jones, and W. B. Woodhouse.

For the three vacancies as Associate Members of Council, consequent upon the retirement of Major E. O. Henrici, Mr. A. W. Martin, and Mr. F. E. Berry, the following names are put forward: **F. W. Crawter** (Manager of the Sales Department, Chloride Electrical Storage Co.), **H. H. Harrison** (Engineer, Automatic Manufacturing Co.), and **W. R. Rawlings** (Wiring Contractor).

There are two vacancies as Associates on the Council due to the retirement of Mr. E. Russell Clarke and Col. A. M. Ogilvie, C.B., and for these Messrs. **James O. Callender** (Assistant Manager, Callender's Cable & Construction Co.) and **J. Devonshire** (Director of several of the Electrical Federation tramway companies) are put forward. Mr. J. Hunter Gray continues as the remaining Associate on the Council.

In addition to the above names, the Chairman and immediate past Chairman of each of the local sections for the time being are also *ex officio* Members of Council.

It is open to any ten Members to nominate other candidates for election before April 21st.

British Trade After the War.—A meeting was held at Manchester last week, under the auspices of the Council for the Organisation of British Engineering Industry, at which an address was given by Mr. T. C. Elder on "Engineering Industry and Public Policy." Mr. Elder's views on this matter are now well known to our readers, they having been expounded at meetings of the B.E.A.M.A., both in London and the provinces. Nevertheless, their reiteration in a centre like Manchester is all for the common good, and on this occasion he received notable support. Among those taking part in the discussion were Mr. S. Z. de Ferranti and Mr. C. H. Wordingham, in addition to a number of prominent members of other branches of engineering. The discussion in Manchester was particularly appropriate, having regard to the work done by the Manchester Engineers' Club and their scheme for reorganising industry by means of a comprehensive association, which will include within its purview all aspects of industry, technical, commercial, and educational. A resolution was passed at the meeting expressing the opinion that the organisation of British industries from within should immediately be undertaken, whilst another resolution urging the Government to create a Ministry of Commerce after consultation with representative commercial interests was also passed.

THE INSTITUTION'S ALIEN ENEMY MEMBERS

AS a result of the two meetings reported in our issues of March 9th and March 16th, the Institution of Electrical Engineers has asked every Corporate Member to state whether he approves or disapproves of the following procedure:—

(*a*) To expel members who are subjects of enemy countries or States.

(*b*) To expel members who, being naturalised British subjects, have retained enemy nationality.

(*c*) *Not* to expel members who are naturalised British subjects and were formerly subjects of a country or State now at war with Great Britain and Ireland, but who have under the laws of such country or State definitely lost their alien nationality, provided they are able to prove this to the complete satisfaction of the Council.

(d) That no person shall after the . . . . day of . . . . be eligible for election as a member of the Institution who is a subject of any country or State with which the United Kingdom of Great Britain and Ireland is or shall have been at war on or after the date mentioned.

A card for this purpose has been sent to every Corporate Member of the Institution. It will be remembered that at the meeting held on March 8th there was a large majority in favour of the course indicated by *a b*, *c*, and *d* above. On the receipt of the cards the Council will draft out an amendment to the Articles of Association to conform with the views expressed by the majority of Corporate Members, and, after the necessary approval of the Board has been obtained, the alterations will be formally submitted to a special general meeting of members, and, if then passed, will be submitted for confirmation at a subsequent general meeting.

THE ELECTRICAL TRADES' BENEVOLENT INSTITUTION

THE annual meeting of the Electrical Trades Benevolent Institution was held at the Institution of Electrical Engineers on Monday, Lord Vaux of Harrowden in the chair. The Annual Report of the Committee states that the income for the past year has been seriously affected, amounting only to £886, against £3,139 10s. in 1914. Grants to the extent of £149 were made. The loss of income is attributed, of course, mainly to the war and also to the fact that the Annual Festival Dinner, which is usually responsible for a large sum in subscriptions, was not held. At the same time, the grants paid were considerably smaller than in the previous year, owing to the fact that there is less difficulty in finding employment. Sir David Salomons has accepted the position of Trustee, and the securities of the Institution have now been transferred into the names of Sir David Salomons and Mr. Hugo Hurst, who together with Mr. Justus Eck are now the three trustees of the Institution. Attention is called to the falling off in the collectors' returns, there having been only five collectors at work during 1915 compared with four or five times that number previously. Lord Vaux, during the course of his opening speech, expressed the opinion that every electrical firm should feel it their duty to see one of their staff acting as a collector for the fund, an increase in the subscribers to which he said he regarded as absolutely essential in view of the possible distress which would follow the conclusion of the war. It was also pointed out that it will become necessary in future to restrict assistance to the members of the Institution. There have been a number of cases in which men assisted have not contributed to the funds at all. The invested funds of the Institution now amount to £8,116. Mr. Justus Eck, who seconded the adoption of the report and accounts, also called attention to the necessity for increasing the membership, and suggested that firms might very considerably increase their donations and subscriptions to the Institution, as he believed the authorities would allow this to go down as working expenses before fixing the amount upon which excess profits had to be paid. Thus, if a firm had £1,000 excess profits and paid £500 into the Institution's funds, they would only be taxing themselves £250, whilst benefiting the Institution to the extent of £500. On this question, however, there is some difference of opinion, although Mr. Eck thinks it is worth trying.

The report and accounts having been unanimously adopted, the following gentlemen were re-elected to the Committee management: Justus Eck, E. F. Johnson, P. A. Lundberg, W. C. Mountain, F. H. Nalder, E. A. Nash, W. R. Rawlings, D. G. Tate. Mr. H. Oppenheimer has resigned from the Committee, and a vote of thanks was passed to him for his services. The Auditors and Hon. Solicitors having been duly re-elected, an alteration in the rules of the Institution, the object of which was to make them a little clearer without altering them in principle, was agreed to.

Railway Overhead Conductor Stolen.—On March 9th the morning trains of the Milan—Gallarate electric railway along the Lake of Lugano to Porto Ceresio were unable to run, as it was discovered that about 650 yards of overhead conductor had been stolen during the night.

EFFECT OF THE WAR ON ELECTRICITY WORKS IN GERMANY

SOME effects of the British blockade, mobilisation, and other war conditions on the operation of steam, water-power, and oil engine plants in Germany were described in an interesting and authoritative article in the *Zeitschrift für Dampfkessel und Maschinenbetrieb* last month.

Shortage of men of all classes was the first effect of the war, and this was followed by an ever-increasing difficulty of obtaining fuel and other necessities. The works which were most unfavourably placed as regards these earlier difficulties were the electricity works, and in particular those supplying tramways and light railways, as the demand for light traffic increased enormously owing to the use of the railways for military purposes and the commandeering of all available horses. In view of this, it is remarkable that the large electricity supply companies are almost the only undertakings that have not increased the charge to the public for their production, even a reduction in price having been effected in some cases, while any continued failure to supply has not occurred anywhere. This, the writer of the article says, should for ever put aside the contention so often made, that any important industrial undertaking should not rely on a public source of supply which would be uncertain in troublesome times. The opposite has indeed been proved, as the large undertaking has had better chances of securing fuel and other necessities than the small private concern.

The organisation and influence of the large industrial trusts have, it is said, been highly beneficial in the prosecution of the war on the technical side, both by assisting in the enormous production of munitions, artillery, and other war machinery, and also by "supporting the home industries" in the occupied territory, the last being a feature of the greatest importance to the invaders. A further advantage of centralised industrialism has been the comparative ease of running large factories and groups of factories with the minimum of skilled trained engineers. This has been especially the case with the large electricity supply undertakings, where centralisation makes it easier for the military authorities to decide what men are indispensable, and thus avoids many hardships that are bound to occur when a number of small undertakings have to be dealt with.

Owing to the large coal production in Germany itself there has been no coal famine, but a shortage was experienced in the earlier weeks, especially by small undertakings without a sufficient storage capacity, owing to the use of the railways for military purposes and the temporary stopping of the steamship services on the water-ways. These difficulties were felt particularly by those districts near Berlin fed from the Silesian coalfields. The shortage of water-power owing to the drought of the summer of 1914 further aggravated this difficulty. Some relief was obtained by the mixing of coke, of which there were ample stores, with boiler coal. The effect of this on the efficiency was bad, but from various other standpoints, such as reduction in smoke emission and reduced deposition of soot on the heating surfaces, the results obtained are said to have been advantageous. With mechanical stokers the admixture of coke also worked well so long as it was well broken beforehand. At present a further use of coke for power plants and locomotives is not encouraged, as this extra demand has had the effect of creating a shortage of coke for the central heating and other furnaces which are specially constructed to burn this fuel only.

While steam operation has proved its reliability and value during the war period, Diesel and other oil engine plants have fallen completely from their high economic level owing to the excessive price and scarcity of oil, and they cannot now even compete with old steam plants running with saturated steam. The price of crude oil had already begun to rise alarmingly before the war, and last month it was difficult to obtain any at even four times the pre-war price, and some classes of oil are absolutely unobtainable.

In the first months of the war there was very little lubricating oil on the market owing to the general requisition for military purposes; now there is said to be ample, but at very high prices. On the other hand, suitable cylinder oil for engines with high superheat is next to impossible to obtain, and extraordinarily dear. As nearly all small plants have reciprocating engines these are especially hit, while the large undertakings with mostly turbines do not suffer so much. In spite of the difficulty of obtaining electrical machinery and apparatus owing to the copper shortage, the substitution of electric drive for private steam, gas, or oil drive has much advanced, chiefly on account of these very difficulties outlined above.

The shortage of lubricating oil has led all engineers to study very carefully the various systems of recovery from waste, &c., but no new systems have been developed. Recovered oil has been mixed with fresh oil in some cases and sold as new, and it has been necessary for the station engineer to give more attention to the possible presence of foreign matter than to such points as flash-point, freedom from acid, viscosity, &c., when purchasing oil. The admixture of graphite, and especially the much-advertised "Flockengraphit," for the purpose of making the store of oil last longer, is not encouraged, except in the case of rough machinery, as in mining work, where the particles fill up the cracks and small irregularities in the bearing surfaces. For the finely-finished surfaces of the better classes of machinery these particles are a nuisance, and only fill up the lubricating grooves. The presence of any solid matter also greatly hinders filtering, which is necessary if one suspects that recovered oil mixed with new has been supplied instead of fresh oil. An increased value to recovery apparatus has been effected by the scarcity of cotton-waste, which can be used again instead of being burnt. When it is not recovered in a state for use again, the greasy residue is used for the lubrication of car axles, points and crossings, &c. The high price of cotton-waste has led many undertakings to adopt cleaning cloths in its place. The oil is extracted from these afterwards, and both oil and cloth used again.

The use of petrol engines for private purposes has almost ceased, only the various official departments being able to obtain the necessary fuel. An admixture of alcohol to the benzol which is used in place of petrol has been attempted, but with the same result as the admixture of coke to coal, namely, a reduction in efficiency, but less deposition of soot on the ignition plugs and exhaust-pipe surfaces. Too much alcohol causes the formation of an acid which rapidly eats away the cylinder surface.

WINDING-UP OF ENEMY FIRMS

THE Board of Trade under the Trading with the Enemy (Amendment) Act, 1916, has issued orders winding up a considerable number of enemy firms in the United Kingdom. We give below a full list of those in the electrical and allied industries: Electrical Co., Ltd., 122-124 Charing Cross Road, W.C.; British Graetzin Light, Ltd., 26-36 Chapter Street, Westminster, S.W.; Ships Carbons (Limited), 5 Chancery Lane, E.C., dealers in carbons for electric lamps; Schoen Brothers, 29-30 Cock Lane, Snow Hill, E.C., agents for the supply of electrical goods; Esslerk, Ltd., 91-93 Bishopsgate, E.C., dealers in electrical carbons.

In reply to a question in the House of Commons last week regarding the Sterling Telephone & Electric Co., Ltd., Mr. Runciman stated that he was aware that £36,200 of the capital of this company is held by residents in Germany. The application of the provisions of the Trading with the Enemy (Amendment) Act, 1916, to this company will be considered in due course.

London Electrical Engineers, R.E. (T.F.).—The following have been gazetted as Second Lieutenants on probation:—F. Charles Raphael, from Anti-Aircraft Corps, R.N.A.S., Feb. 24th; Chief Petty Officer H. J. Waller, from Anti-Aircraft Corps, R.N.A.S., March 2nd; Corporal A. J. Anido, March 18th; Sapper F. G. Hort, March 18th; Lce.-Corp. C. W. Salt, March 20th; Sapper E. H. Duckworth, March 20th; and Sapper F. Harris, March 20th.

Chief Technical Assistants' Association.—The first annual general meeting of this Association was held recently, when Mr. J. T. Baron was elected chairman. Messrs. T. K. Richardson and W. Young were elected vice-chairmen; Messrs. H. F. Thompson and J. H. Parker were added to the Committee; the Hon. Secretary is Mr. A. P. MacAlister, and the Hon. Treasurer J. R. J. Bowden. The membership now includes practically every deputy electrical engineer in Greater London, and in the large stations the senior technical assistants. Consequently it is anticipated that the Association will no longer continue to develop so far as membership is concerned, and this fact has rendered it possible to define exactly the scope of the Association. As it is affiliated with the Association of Municipal Electrical Engineers (Greater London), questions of policy are not to be dealt with. Monthly meetings are to be held, however, at which Papers on technical matters will be read and discussed, and during the past half-year discussions have taken place on the advisability or not of earthing the neutral of a three-phase high-tension system, and the best method of earthing; safety devices on high-tension systems; station economics; high-tension switchgear and mains laying. Future meetings are arranged for April 15th, May 13th, June 10th, July 8th, and September 9th, at the Tavistock Hotel, Covent Garden, at 3 p.m.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

Questions : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,488.

Three six-phase 500-k.w. rotary converters are run direct from a turbo-alternator through the necessary switchboard connections. The alternator has an exciter on the end of its shaft, and it is proposed to lower the D.C. voltage on rotaries by lowering the voltage on exciter, the alternator and rotaries being fully loaded. Is it possible to do this, and is there any danger in doing so?—Rotary.

(*Replies must be received not later than first post, Thursday, April 6th.*)

ANSWERS TO QUESTION No. 1,486.

I have two 3-phase 25-h.p. motors driving each through a spur wheel fixed at each end of one common shaft. I find on applying current through a controller that these motors "kick" badly, and motion is very erratic. The motors run well when disconnected from the shafting, and when one motor is cut out they run almost equally well. Can any of your readers state the cause of this trouble and suggest a remedy for it?—Unico.

The first award (10s.) is made to "Y. Z." for the following reply :—

The description of the trouble indicates that it is due to the rotors of the two motors, which are mechanically coupled together through the gearing and shafting, not being properly disposed on their shafts relatively to each other. They are apparently slip-ring rotors, started in parallel from a common starter. An induction motor, as is well known, is equivalent to a transformer, and its rotor has induced in it an electromotive force dependent in magnitude and phase on the electromotive force acting on the stator. The exact relation between the stator and rotor electromotive forces is not of importance as regards magnitude; the rotor can be considered merely as having its electromotive force produced by the more or less uniform and uniformly rotating field produced by the stator winding. The moment in time at which the electromotive force in any phase of the rotor reaches its minimum, say, during any cycle, depends on the space relation between the stator phases and the rotor phases; if this relation is the same in both motors driving the shaft, then each rotor will have its instantaneous electromotive force value exactly the same as that of the other rotor at any given moment, but if the angular relation between the windings is not the same in the two machines, the rotor electromotive forces will not be in phase with each other.

Now the effect of connecting the two rotors through their slip-rings to a common controller at starting, so allowing the electromotive forces of the rotor windings actually to generate current, which ordinarily flows in the coils of the starting resistance, is in this case to put the rotors in parallel also. If the rotor electromotive forces are in phase with each other, the arrangement will work well, and each will give the same current in the coils of the starter, and afterwards, when the starter is cut out, everything will be, of course, quite normal. But if the instantaneous values of rotor electromotive forces are not the same, an extra current will flow between the rotor windings, tending to neutralise this difference, and the greater the difference in phase, the greater will be the current set up. This current influences the whole relations of the motors, and by reacting on the stator, upsets the running, so that the motors start up badly, and, in fact, will not run in parallel at all. Presumably the motors are alike, but there may be small differences in performance between them under the abnormal conditions set up, and these, as they occur, will cause jerks in the reaction effect, so that the rotors will move erratically as described.

Once the cause of the trouble is clear, the remedy is also clear. One method of curing the trouble would be to run up on one motor only with the starter, and then, when up to speed, switch in the other, as the latter would clearly not need any starting resistance under these conditions. It could be switched in with its rotor short-circuited, and entirely disconnected from the other rotor, so that no question of any cross-current could arise.

The question speaks of a controller, and it may be that it is to regulate the speed of the motors by inserting resistance in the rotor circuits. In that case, the above remedy would be inapplicable. A better remedy, on the whole, is therefore to adjust the angular position of the rotors until the voltages come into phase with each other. One motor should be withdrawn from gearing with the spur-wheel, the rotor should be turned round through one tooth of its pinion, and replaced. An attempt to start will now show whether improvement has taken place or not. The result of this will show whether to move the rotor still further round relatively to the other in the direction started on, or to go the other way round. A little experimenting in this way will soon result in a position being obtained where the two rotors do not set up a cross-current. This will be indicated by smooth starting and running of both machines, and when this point is reached, adjustment stops. The rotors are definitely locked together correctly by the gear, and remain so; hence an adjustment once made will remove the trouble once and for all.

The second award (5s.) is made to "L. R." We give his reply in abridged form :—

The particular type of motor employed is not stated, nor is it said if both motors are strictly alike. It will be assumed, therefore, that they were alike, and that in all probability they were induction motors with wound armatures. This is most likely to be the fact.

Now there are several possible causes of irregularity. In the first place, the starting torque of induction motors varies with the position of the rotor, and if the two rotors should not be in the same position as regards the tooth pitch, the torque applied at each end of the shaft will be different, it may be by a considerable amount. Therefore in some cases the motor with the greatest torque would be driving the other machine to a certain extent; this would react on the slip of that machine, which again would affect the torque, the result being very uneven running. To remedy this, it is just possible that one might be able, by altering particular teeth which are in gear, to bring the rotors into the same position, so that they will give equal torque effects, but probably it would be better to introduce an element of flexibility in the drive, such as replacing one of the gears by a belt drive. A certain amount of slipping would then take place at the belt which might be sufficient to wipe out the irregularities due to varying starting torque. There are other ways in which the effect of the varying starting torque can be reduced. One is by increasing the momentum of the machinery driven from the motors, and another is by choosing motors with a considerable slip.

The difficulty may be partly due to placing the gears at the ends of the shaft. They should be placed in the middle, otherwise a sudden heavy load, such as may be caused in starting, may give serious torsional oscillations and appreciable unbalancing. The effect cannot be predicted in this particular case, because the length of the shafting is not given. Another point that should be borne in mind is that the characteristic curves of the motors should be the same and that they should have the same drop in speed for a given load increment.

The Batti-Wallahs' Society.—At the annual meeting on the 20th inst., the following officers were elected for the ensuing year :—President : Lieut. H. T. Harrison; Vice-Presidents : C. H. Russell, E. P. Barfield, Wm. Wyld, R. W. Hughman. Past-Presidents : J. F. Avila, L. M. Waterhouse, W. Riggs, M. S. Chambers, F. J. Collis, J. S. Huddleston. Committee : E. E. Sharpe, W. E. Warrilow, W. E. Ireland, J. P. Maginnis, G. Campbell, P. S. Doherty. Secretary and Treasurer : F. Pooley, 25 Victoria Street, S.W. Entertainment Secretary : A. J. Greenly, 36-38 Strand, W.C. Assistant Secretary : W. L. Wreford, 25 Victoria Street, S.W.

GERMAN TELEPHONE MANUFACTURERS

A NUMBER of contracts entered into before the war by British firms for the supply of telephone apparatus and parts by German firms were declared void by Mr. Justice Bray in the King's Bench Division on Monday.

The first application was made on behalf of the Lancashire & Yorkshire Private Telephone Co., of Queen Street, Albert Square, Manchester, in respect of a contract made with the Telephon and Telegraphenbau, Gesellschaft, of Frankfurt, and Mr. Harry Fuld. The defendants were not represented. Mr. F. T. Jackson, Managing Director of the Lancashire & Yorkshire Private Telephone Co., stated that in March, 1910, his company entered into an exclusive agreement with the defendant company for the supply of telephone apparatus. Before the outbreak of war he and Mr. Fuld were the directors. A portion of the shares was held by Mr. Fuld, 300 shares were held by a Belgian gentleman, and others were held by witness and several other English shareholders. Witness and Mr. Walker were at present the directors. Mr. Fuld's interests had been disclosed to the Public Trustee, as well as details as to the debts owing to the defendant company. For the purpose of carrying on the company's business, apparatus had been hired by the plaintiff company. It was necessary to have spare parts delivered in order to keep the telephone instruments in working order. They could not get these spare parts from Germany, and it was necessary to enter into fresh contracts with British manufacturers for this purpose.

Mr. Justice Bray granted the declaration applied for.

A second case against the same defendants was heard, in which the I.T.C., Ltd., of Great Portland Street, London, were the plaintiffs. Mr. Disturnal, K.C., stated that plaintiffs sought to obtain a declaration that certain agreements between the plaintiffs were determined owing to the war. The first agreement was made on April 28th, 1908, between the defendant company and Mr. Hugo Meyer, and a second agreement was dated October 8th, 1908. Under these agreements plaintiffs were to take the apparatus from the German company and from no other company for a period of 35 years. A declaration was granted in this case, and also in a third instance, plaintiff being the New System Private Telephone Co., of Great Portland Street, London, and the defendants the Deutsche Privat Telefon Co. The facts were similar to those in the previous cases.

THE SCIENTIFIC UTILISATION OF FUEL

ONE of the most practical things accomplished at the British Association meeting at Manchester last year was the appointment of a Committee under the Chairmanship of Prof. W. A. Bone, F.R.S., Professor of Chemical Technology at the Imperial College of Science, London, to investigate in as thorough a manner as possible the many questions relating to fuel economy. Since then considerable progress has been made in the matter, and serious attention is being given to it in many quarters. Prof. Bone, with characteristic energy, has not only outlined a scheme for carrying on the work entrusted to him, but has sub-divided the work of his Committee into five sections, each in charge of a special Committee. The first will deal with chemical and statistical matters, the second has under consideration questions relating to carbonisation, coke ovens, and the by-products to be derived therefrom, the third deals with power and steam raising, including the organisation of public power schemes (this is under the Chairmanship of Mr. C. H. Merz), the fourth is in charge of metallurgical problems, and the fifth will co-ordinate the work of the various smoke committees throughout the country. The first step to be taken by these sub-committees is to collect all available information and to report to the General Committee, which will sit at intervals to pass judgment upon any conclusions arrived at by the sub-committee.

The Committee views the national aspects of fuel economy from two standpoints, first from that of the economic situation created by the war, and the need for enforcing national economy as the best means for paying for the war, and, secondly, in the interests of that remoter, but nevertheless in some people's opinion not far distant, future when our coal supplies will be restricted by approaching exhaustion. Upon this basis Prof. Bone has suggested a systematic investigation of the chemical nature of coal, which he thinks may best be undertaken by a selected group of experienced chemists aided by adequate grants from public research funds; secondly, a chemical survey of the principal British coalfields which ought to be organised by a public department, acting in conjunction with the laboratories already established for the special study of fuel technology at the Universities and other institutions for advanced research in applied science. The practical aspect of the matter, however, which will appeal to central station engineers is the steps which should be taken to avoid the burning of coal in its crude state for the purposes of steam raising. It is admitted that in the present state of gas engines a somewhat higher efficiency can be obtained from a modern steam plant working in conjunction with coal fired boilers, but the idea which Prof. Bone and many others have in mind is the raising of steam only by means of gaseous fuel.

Bearing on this question, some interesting remarks were made by Sir Richard Redmayne, K.C.B., Chief Inspector of Mines to the Home Office, in his Presidential Address to the Institution of Mining and Metallurgy on Thursday last week. Sir Richard comes to the conclusion that it is probably understating the case to say that the present power requirements of the country could be met by utilising one-third of the fuel consumed at present if, instead of the fuel being utilised in small units of machinery, its use were concentrated in large generating centres in the hands of bodies specially constituted for the purpose. The proper development of such a business involves spending capital upon which, however efficiently it is done, the return would probably not be more than 1 per cent. during the first year, rising by, say, 1 per cent. per annum to a proper return. The German States particularly had appreciated this point and had inaugurated a system of granting loans to operating companies, commencing at a very small rate of interest and rising gradually to a reasonable rate. The financing of such undertakings could be done in this country either by the State or by a modification of the present system of banking. The amount of capital involved in dealing with the problem as suggested with a view to accelerating progress was not really large; £2,000,000 or £3,000,000 a year for ten years properly spent would go a very long way to starting things on the right lines, and in five years' time the State would have, if it were the financing agent, a very satisfactory revenue in the shape of rentals. Another obvious feature in the case was the enormous income amounting to many millions per annum which would be derivable from the increased quantity of coal available for export. Sir Richard Redmayne believes that matters could be accelerated by legislation and by closer co-operation between municipalities and companies operating in adjacent territories.

THE POSTMASTER-GENERAL'S ANNUAL REPORT

THE Annual Report of the Postmaster-General for the year ended March 31st, 1915, deals, as usual, with a number of matters relating to telephony, telegraphy, and wireless telegraphy, although the tendency of the report in these, and, indeed, generally, is to be somewhat briefer than usual. It is interesting to note that the substitution of the telephone for the Morse sounder as a telegraph instrument has been forced upon the Department through dearth of trained staff, the telephone being in use as a substitute for the telegraph at 7,350 sub-offices. Similarly the use of high-speed printing telegraph machines has set free a number of telegraphists who would otherwise have been employed on manipulative work. A new instrument manufactured by the Western Electric Co., similar in design to the Murray multiplex, has been installed on the London-Manchester route with good results It provides for eight channels on one underground circuit, four in each direction, worked by means of type keyboards. Baudot working has been extended, and is now in force between London and Birmingham, Liverpool and Glasgow, and is to be introduced on the London-Brighton route. The use of "phantom" circuits superposed on telephone trunk and junction circuits has been extended, this having been found essential owing to the withdrawal from their normal use of a large number of aerial wires for military purposes. A second superposed circuit to be worked with Wheatstone apparatus is being installed between London and Southampton, and the arrangements made for utilising "phantom" circuits in Scotland between the more important centres have proved their value in actual practice.

No licences for fresh wireless stations have been issued during the year, the number of licences remaining the same as at the outbreak of war—namely, 2,158. Between April 1st and July 31st, 1914, however, 326 new licences were issued for experiments or the reception of time-signals, while 131 licences for experimental stations had been cancelled or had expired. Permission to conduct temporary experiments was given in 26 cases. There was an increase of about 31 per cent. in the number of radio-telegrams dealt with at Post Office coast stations between April 1st and July 31st, 1914, compared with the corresponding period of the previous year.

The war has affected seriously the telephone side of the Post Office work, new orders having fallen off to the extent of approximately 27 per cent. since war was declared, whilst the number of subscribers giving up their telephones has increased by 29 per cent. On the other hand, nearly 10,000 circuits have been provided specially for naval and military authorities and other Government Departments for emergency purposes. With regard to automatic exchanges, these are now working at the G.P.O. (London), Accrington, Chepstow, Darlington, Epsom, Hereford, and Newport, and are giving a satisfactory service, whilst similar exchanges are being installed at Blackburn, Dudley, Grimsby, Leeds, Paisley, and

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published March 23rd, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

8,349/14. **Plug Connectors.** H. EICKMANN. A strip consisting of two conductors of U-shape embedded in an insulating filet so that an ordinary two-pin plug can be inserted at any point. One end of each length of strip is in the form of a plug, and the other in the form of a socket, so that any number of such lengths can be coupled together. (Three figures.)

7,498/14. **Conductor Rail Anchors.** H. SCOTT. An anti-creeping clip for conductor rails on electric railways, comprising two separate parts, each of which is formed with a straight portion to engage the rail web and a bifurcated, curved or bent portion to fit around the base flange of the rail and engage the insulator, the two parts being secured together by three bolts, one passing through the web of the rail. (Three figures.)

9,628/15. **Electric Welding.** B. T.-H. Co. (*G.E. Co., U.S.A.*). An improved "spot" welding machine, in which the upper electrode is rotated or moved about while pressed on to the work in order to clean off scale, dirt, &c. (Three figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: ROOTHAAN and FERRANTI, LTD. [Insulators] 10,421/15; HOCHSTADTER [Distributing systems] 11,457/15.

Dynamos, Motors, and Transformers: BRINDLEY [Motor control] 7,638/15.

Electrometallurgy and Electrochemistry: BELL and SCOTT [Electrodeposition of metals] 3,569/15; SCOTT and HOWLES [Electric furnaces] 3,953/15.

Heating and Cooking: QUAIN [Radiators] 3,575/15; HEARN [Heating element for kindling] 4,600/15; AUTOMATIC TELEPHONE MANUFACTURING Co. and ARCHER [Heating apparatus] 14,746/15; SMITH [Liquid heater] 17,413/15.

Ignition: MONTAGUE [Magnetic drive] 5,928/15; LONGFORD, LONGFORD and CLARK [Sparking plugs] 8,696/15.

Incandescent Lamps: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Exhausting apparatus] 3,410/15; B.T.-H. Co (*G.E. Co., U.S.A.*) [Incandescent lamps] 8,421/15.

Switchgear, Fuses, and Fittings: HOCHSTADTER [Protective system] 21,992/14; CHELL [Lanterns] 2,004/15; ROEDDING and ROEDDING [Push buttons] 3,706/15; WYNNE [Switches] 3,733/15; RAILING, GARRARD and GREENHALGH [Resistances] 8,860/15; FILDES [Fittings] 10,350/15.

Telephony and Telegraphy: JENKINS [Sanitary telephone mouthpieces] 3,329/15; INTERNATIONAL ELECTRIC Co., ROOSE and LE NOIR [Telephony] 3,523/15; NAAMLOOZE VERMOOTSCHAP DE NEDERLANDSHE THERMO-TELEPHOON MAATSCHAPPIJ [Wireless telegraphy and telephony] 3,954/15.

Traction: MEYER [Trolley poles] 24,074/14.

Miscellaneous: ALAND [Condenser connections] 15,580/14; STERN [Impulse transmitters for signalling] 3,420/15; WOLSELEY MOTORS, LTD., and REMINGTON [Electric marine propulsion] 4,172/15; HEUSNER [Safety device for quartz lamps] 8,753/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [X-Ray devices] 9,346/15; FAHY and OTWAY [Resuscitation of Leclanché cells] 11,511/15; HEIBERG [Table lamp] 17,116/15.

The following Specification is open to Inspection at the Patent Office before Acceptance, but is not yet published for sale.

(Numbers in brackets refer to the new system of numbering.)

Instruments: F. WUNSCH [Measuring apparatus] 3,254 (*100,139*).

Opposition to Grant of Patents

Opposition has been entered to the grant of a patent on the following application:—

580/15. **Telephony.** RELAY AUTOMATIC TELEPHONE Co. and W. W. AITKEN. A calling system for B operators' positions showing as many signals as there are lines calling, and preventing more than one line from being connected with the B operator's telephone.

The grant of a patent on the following application has been allowed in spite of opposition:—

22,435/14. **Lock-out Switches.** T. E. BARNUM and W. E. DATE. Electromagnetic switches for motor control, &c., controlled by separate and opposing electromagnets energised by a common current, which if it does not exceed a predetermined value operates to close the switch, but if it does exceed that value prevents it from closing.

An appeal has been lodged against the decision of the comptroller to allow the grant of a patent on the following application in spite of opposition:—

17,133/14. **Electro-deposition.** T. R. HARRIS. A process of electro-deposition of metals on revolving cylinders, using a high current density and a sprayed electrolyte.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

9,689/02. **Railway Signalling.** J. B. STRUBLE. A track circuit signalling system actuated by A.C.

7,995/02. **Electro-deposition.** P. JENSEN. Deposition of tough, even deposits from electrolytes containing ether sulphuric acids, or salts thereof.

The following are the more important patents that have become void through non-payment of renewal fees.

Arc Lamps: J. T. H. DEMPSTER [Flame carbons] 26,915/04; C. P. STEINMETZ [Flame carbons] 26,916/04; J. HÄRDÉN [Flame carbons] 26,918/04; C. F. LINDSAY [Flame carbons] 26,920/04.

Storage Batteries: T. A. EDISON [Metal films used in manufacture of active material for alkaline battery plates] 16,701/06.

Telephony and Telegraphy: A. J. BOULT (*F. Lori and E. Solari*) [Multiple resonance telegraphs] 25,754/05.

Traction: D. BALACHOWSKY and P. CLAIRE [Resiliently driving A.C. motors] 28,475/09; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Motor control] 28,941/09.

Miscellaneous: R. F. VENNER [Illuminated head signs] 26,331/08.

Portsmouth. Owing to various difficulties caused by the war, the introduction of automatic exchanges has not proceeded so rapidly as was anticipated, and it is not yet possible to judge whether a wide expansion of automatic working would be justified.

On March 31st, 1915, the total mileage of Post Office wires, including spares, was 3,071,867 (single), an increase of 6·4 per cent. for the year, made up as follows:—Telegraphs, 265,765; telephones, 2,806,102; the total being divided into aerial, 997,292; underground, 2,060,918; submarine, 13,867.

An interesting feature of the report is information concerning the assistance which has been rendered by the Post Office Stores Departmnt to the Admiralty and War Office, many urgent demands for telegraph and telephone apparatus from this department having been dealt with since the outbreak of war. On one occasion the whole of the material required for an urgent work, weighing over 100 tons, and including 350 poles, 37 tons of wire, and 45 tons of general stores and apparatus, was assembled from various parts of the country and despatched within twenty-four hours. In all, some 16,000 telegraph and telephone instruments, including 460 telephone switchboards, 450 telegraph sets for key-working, and 123 Wheatstone automatic sets were issued for naval or military purposes during the period ended March 31st, 1915.

Of the 35,000 Post Office servants with the Forces, about 8,000 are in the Royal Engineers (Signal Companies) and about 1,500 in the Royal Engineers (Post Section) at the date of the report. These figures have since been largely increased.

The Electric Vehicle Committee.—In the recent announcement of the Electric Vehicle Committee relative to standardised overall sizes for lead-plate batteries (ELECTRICAL ENGINEERING, March 16th, p. 97), it should have been stated that the overall sizes agreed upon by the members of the Accumulator Manufacturers' Section of the B.E.A.M.A. are the maximum sizes, the intention being that the dimensions will cover any maker's cells containing each the same number of plates. This has been done in order that vehicle makers may so construct the battery boxes on vehicles that cells of a specified number of plates of any make may be fitted.

LOCAL NOTES

Belfast: *Action for Alleged Slander.*—At the County of Antrim Assizes last week an action by Mr. A. B. Farrell, formerly Resident Superintendent at the Belfast Electricity Works, against Mr. T. W. Bloxam, Belfast City Electrical Engineer, for alleged slander was heard. Mr. Farrell was for fifteen years in the service of the Corporation, and the statements complained of were alleged to have been made in conversation between Mr. Bloxam and certain members of the Electricity Committee reflecting upon the ability of Mr. Farrell. For the defence the case was that the City Electrical Engineer was merely placing before his Committee the facts of the position, and the claim for £1,000 damages was characterised by Mr. Bloxam's counsel as a victimisation for doing his duty. The action lasted four days. Eventually the jury found that the plaintiff spoke the words complained of, that they were not spoken honestly in the belief that they were true, and that they meant the plaintiff had been guilty of gross misconduct and negligence and was incompetent and unfit to be superintendent of the electric power station. They also held that the words were spoken maliciously, and awarded £500 damages.

Birmingham: *Coal Clauses and Power Contracts.*—The question of agreements for the supply of high-tension current was under discussion at the last meeting of the Electric Supply Committee in connection with coal clauses. There are a number of old agreements still in force in which there is no coal clause, but it was reported that Messrs. Cadbury, who are working under one of these, have agreed voluntarily to pay for current under the terms imposed under new power contracts. The Committee express the hope that other power users will follow Messrs. Cadbury's example.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Accrington.—The Council has decided to go forward with a scheme of extensions owing to the power-station plant being overloaded.

Australia.—Specifications in connection with tenders for 533,000 flame arc lamp carbons are at the Board of Trade, 73 Basinghall Street. Tenders by April 11th to Melbourne City Council agents, Messrs. McIlwraith, McEacharn & Co., Billiter Square Buildings, E.C., by April 11th.

Barnes.—Extensions are contemplated. The Engineer reports that the moment is favourable to instal a turbine set rather than add further reciprocating engine sets.

Edinburgh.—An additional expenditure of £11,000 has been sanctioned on the McDonald Road power-station. Among the plant required are transformers and mains.

Miscellaneous

Australia.—The Melbourne Deputy Postmaster-General requires 8,500 fuses. Tenders by April 18th. This information, of course, is only of use to firms who can cable agents.

Bray.—Stores for the electricity supply department. Clerk. April 4th.

Kirkcaldy.—Stores for the electricity supply department. Borough Electrical Engineer. April 3rd.

Southampton.—Twelve months' supply of meters. Borough Electrical Engineer. April 8th. (See an advertisement on another page.)

Change of Address.—The Keighley Gas & Oil Engine Co., Ltd., has removed to Imperial House, Kingsway, W.C.—Mr. Sidney F. Walker has removed from Bloomfield Crescent to 85 Shakespeare Avenue, Alexandra Park, Bath.

Griffiths Bros. & Co.—Mr. J. Russell Thornbery, sole proprietor of Griffiths Bros. & Co. and D. Judson & Son, paint, enamel, and varnish manufacturers, &c., has for personal and family reasons converted these two businesses into a private limited company under the style of Griffiths Bros. & Co., London, Ltd. No further capital is being asked for, no capital is being withdrawn, no debentures are being issued, nor is any change being made in the *personnel* or conduct of the business.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Barrow-in-Furness.—A contract has been entered into with the British Thomson-Houston Co. for a rotary converter and switchgear at £2,760.

Croydon.—The Tramways Corporation has accepted Messrs. Siemens Bros. Dynamo Works' tender for Wotan, Tantalum, and carbon filament lamps for the ensuing year.

London: *Marylebone.*—The Electricity Committee reports that tenders for six months' supply of small house cable, flexible cords, rubber goods, and insulating materials are so indefinite that none should be accepted. The management is to buy in the open market as and when occasion arises.

The tender of the British Insulated & Helsby Cables, Ltd. is recommended for acceptance for underground cables.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Metropolitan Electric Supply Co.—The dissatisfaction with the management of this Company to which we referred in our issue of March 9th, page 90, was more or less amicably dealt with at the annual meeting on Wednesday last week. As the result of a circular sent out by a number of shareholders, asking for support for the appointment of a Shareholders' Committee, a fairly powerful opposition was got together, and the directors, realising this, got into communication, prior to the meeting, with those who had started the opposition. The result was the appointment of a Shareholders' Committee, consisting of Mr. W. S. Poole, Mr. J. R. B. Gregory, and Sir Mevill Beachcroft, to examine into the affairs of the Company. This necessitated the adjournment of the annual meeting until Tuesday, May 2nd, in order to allow time for this Committee to report to the shareholders. Mr. W. Harrison Cripps, the Chairman of the Company, who presided at the meeting, dealt with the general position of the Company, in which he pointed out that the war had involved a gross loss of over £30,000 in lighting revenue, and an enormous rise in the cost of production, whereas prior to the war the position of the Company was gradually improving. Nevertheless, even at that time the Board was not satisfied with the position, and thought it well to revert to the plan which had answered so well under the late Mr. Conacher, namely, to allow the engineer to devote his full time to the engineering department, and to appoint in addition a business manager. A revision of contracts entered into before the war was being carried out as far as possible, and a complete reorganisation of the scale of charges commensurate with the increased cost of production had been accomplished with scarcely any friction with the consumers. Mr. P. D. Tuckett, one of the directors who resigned, explained the position at length, from which it would appear that the reason for the resignation of himself, Lord Avebury, and Sir James Pender was disagreement with the Chairman and the Rt. Hon. Leverton Harris as to the policy of dealing with the power load. He referred to reports made by the two latter gentlemen in which they advocated discouraging power load at prices below 1½d. per unit. He paid high tribute to Mr. J. S. Highfield, who, he said, had also resigned because he could not agree with the policy of the Board with regard to power supply. At the conclusion of the meeting the Chairman said he would take an early opportunity of refuting the views which Mr. Tuckett had attributed to him.

North Metropolitan Electric Power Supply Co.—A dividend of 6 per cent., and a bonus of 4 per cent., is recommended on the ordinary shares for 1915, carrying forward £6,043.

W. T. Henley's Telegraph Works.—A final dividend is recommended on the ordinary shares making 15 per cent. for the year. There is also a bonus of 10s. per share less tax. In 1914 the dividend was 15 per cent. with a 5s. bonus.

Clyde Valley Electrical Power Co.—The receipts for 1915 showed a marked increase over the previous year, namely, from £148,000 to £199,500, the net revenue being greater at £90,000 against £68,300. The Ordinary shares receive no dividend, but large sums are placed to contingencies, writing off Parliamentary expenses, &c., and special reserve will carry forward £12,600.

British Insulated & Helsby Cables.—A final dividend, making 15 per cent. for 1915, is recommended, together with a bonus of 2½ per cent., carrying forward, subject to excess profits duties, £160,096. This is after allocating £50,000 to reserve, £35,000 to depreciation, £8,500 to special reserve, and £5,000 to first mortgage debenture redemption.

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £135 to £137 (last week the same).

ELECTRICAL ENGINEERING.

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SUMMARY

The methods employed to avoid the fluctuations in load in an electric furnace, due to the short-circuiting and open-circuiting of the electrodes, are detailed in a description of a recent German furnace on p. 120.

The patents relating to electrical mining and metallurgical subjects published during last month include mining signalling gear, electrolytic production of zinc and of metallic type moulds (p. 120).

We publish an illustrated description of a new type of control equipment for winders and hoists, developed by the British Thomson-Houston Co., Ltd. It consists of master controller, contactor panels, and grid-type resistances (p. 121).

An informal discussion on "Methods and appliances for the attainment of high temperatures in the laboratory," took place at a meeting of the Faraday Society on March 15th. The discussion was opened by Dr. J. A. Harker, F.R.S., of the National Physical Laboratory, who dealt chiefly with the carbon resistance furnace (p. 122).

Mr. J. Christie, chief electrical engineer to the Brighton Corporation, has overcome corrosion difficulties in his condensers by means of an electrolytic process (p. 122).

Our Questions and Answers page this week deals with a trouble which occurred on attempting to synchronise a three-phase machine, owing to the supply cables having been accidentally crossed (p. 123).

Among the subjects of specifications published at the Patent Office last Thursday were protective systems for networks, lamp exhausting, fixation of nitrogen, wireless telegraphy, and resuscitation of Leclanché batteries. Amendments have been allowed of a specification of insulator manufacturing machinery. The grant of a patent for engine-starters has been appealed against. A patent for multiple unit train control expires this week, after a full life of 14 years (p. 124).

A number of new developments in wireless telegraphy which have been put to military use by the Italian authorities are the result of researches by Mr Marconi (p. 125).

The annual meeting of the I.M.E.A. will be held in London on June 22nd and 23rd. The presidential address and three Papers are down for reading (p. 125).

The Proceedings of the American National Electric Light Association last year are reviewed. They fill four volumes, and deal with every side of supply station practice (p. 126).

A dispute with regard to wiremen's wages has been referred to arbitration at Dundee.—Marylebone Electricity Department is paying 65 per cent. more for coal than early in 1915 (p. 127).

Plant is required at Pembroke and in Australia (p. 127).

Arrangements for the Week.—*Saturday, April 8th.*—Birmingham and District Electric Club, Swan Hotel, New Street. "Standard Time and its Distribution by Telegraph," by W. H. Whitehouse. 7 p.m.

Monday, April 10th.—Institution of Electrical Engineers, Newcastle Section, Mining Institute. "The Nature of Electrical Insulation," by Dr. W. M. Thornton. 7.30 p.m.

Tuesday, April 11th.—Institution of Electrical Engineers, Scottish Section, 207 Bath Street, Glasgow. "Branches from E.H.T. Circuits," by D. M. Macleod. 8 p.m.

Wednesday, April 12th.—Institution of Electrical Engineers, Yorkshire Section. Philosophical Hall, Leeds. "Electric Heating: its Present Position and Future Development," by G. Wilkinson. 7 p.m.

Association of Engineers-in-Charge. St. Bride's Institute, Fleet Street, E.C. "Steam Turbines," by G. Stoney, F.R.S. 8 p.m.

Liverpool Engineering Society. At University. "Electric Power in Quarry Operation," by G. K. Paton.

"Dynamicables." Anniversary Meeting and Dinner. Trocadero, Piccadilly. 7.30 p.m.

Thursday, April 13th.—Institution of Electrical Engineers. "The Present Position of Electricity Supply in the United Kingdom and the Steps to be taken to Improve and Strengthen it after the War." 8 p.m.

ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEERS CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D.

Drills, 6.25 to 7.25 : 7.25 to 8.25 p.m.

Thurs., Apr. 6th: Shooting for Sections I. & II., and signalling class.

Fri., Apr. 7th: Sections III. & IV., technical. Sections I. & II., squad. and platoon. Signalling class and recruits.

Sat., Apr. 8th: Uniform parade at 2.45 p.m.

Mon., Apr. 10th: Sections I. & II., technical; Sections III. & IV., squad. and platoon. Signalling class and recruits.

Tues., Apr. 11th: School of arms, 6 to 7 p.m.

Thurs., Apr. 13th: Shooting for Sections III. & IV.

Fri., Apr. 14th: Sections III. & IV., technical; Sections I. & II., squad. and platoon. Signalling class and recruits.

Sat., Apr. 15th: Adjutant's instruction class at 2.30 p.m.

What is Munitions Work?—The first appeal from a Munitions Tribunal as regards the granting of a leaving certificate to an employee came before Mr. Justice Atkin in the King's Bench Division on Friday. Although the case in point does not relate to the electrical industry, nevertheless it is of considerable importance having regard to the extent to which the industry, both on the manufacturing and supply sides, is engaged on war work. The North Staffs Munitions Tribunal in March granted a leaving certificate under the Munitions of War Act to an employee of the Lincoln Waggon Company. The Company objected to the certificate on the ground that the employee had been engaged on munition work, *i.e.*, repairing railway waggons, the argument being that this came within the definition of war work as laid down in the Munitions of War Act. The tribunal, however, took the view that as the man had during the last six weeks of his service been partly engaged in repairing colliery companies' waggons and partly in waggon lifting, he had not been employed on munitions within the meaning of the Act. The case was adjourned in order that the Ministry of Munitions might be represented, it being felt that the question is of the widest importance.

Birmingham Section of the Institution.—The annual meeting of this section of the Institution of Electrical Engineers will be held on May 3rd, when the officers for the 1916–17 session will be elected. The following are the new nominations: Chairman—Col. J. F. Lister, R.E.; Vice-Chairmen—S. T. Allen, N. B. Rosher. Ordinary Members of Committee—F. H. Clough, T. Plummer, E. O. Turner. Further nominations should reach the Hon. Secretary, Mr. J. D. Morgan, at 13 Temple Street, Birmingham, not later than Wednesday, April 12th.

Cost of Supply Connections.—Owing to the difficulty of obtaining Treasury sanction to new loans, the Stepney Electricity Department is asking new consumers to pay the cost of the necessary service cable. The only alternative is to refuse new consumers altogether. It is hoped, however, that when the time comes for the Treasury to grant loans more freely, some part of the charge now made to new consumers will be refunded.

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

THE AVOIDANCE OF LOAD FLUCTUATIONS WITH AN ARC FURNACE INSTALLATION

One of the chief difficulties attending the operation of any type of arc furnace is the frequency and extent of the fluctuations in the power input due to the short-circuiting and open-circuiting of the electrodes. Some interesting details of a steel furnace installation at the works of the Sosnowicer Röhrenwalzwerke u. Eisenwerke A.G., where this difficulty has been largely overcome, are given by Herr W. Kunze in a recent issue of the *Journal* of the German Institution of Engineers.

The works decided to instal an electric furnace to convert their waste material into high-quality steel, but its size was limited by the fact that only 640 kw. was available from their direct-current power station, the total capacity of which was only 1,140 kw. Further, while an A.C. arc furnace was considered the most suitable for the purpose, it was necessary that the current fluctuations, as measured on the direct-current side, should not be greater than 5 per cent. over the normal load circuit, as greater variations than this resulted in serious irregularity of drive of the shop machinery owing to the heavy voltage drop of the generating plant.

The installation was put in by the Westdeutsche Thomasphosphatwerke G.m.b.H., of Berlin, and the Bergmann-Elektricitätswerke, also of Berlin. A furnace of the Nathusius

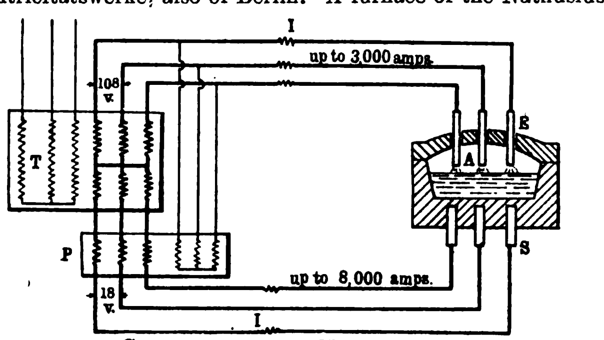

Diagram of Connections of Nathusius Arc Furnace. A, Arcs; E, Arc Electrodes; S, Supplementary Electrodes; I, Instrument Transformers; T, Transformer; P, Pressure Regulator.

type, with a capacity of 5 to 6 tons, was chosen, but has been adapted for charges of from 3 to 4 tons only for the present. For the current supply, a combined generating and converting set has been provided for. This now comprises a 700-kw., 500-volt, 1,500-r.p.m. direct-current motor and a 937-k.v.a., 3,000-volt, 50-cycle three-phase generator coupled together, and provision for a steam turbine on the same bedplate which will be coupled to the free end of the direct-current motor. The capacity of the turbine will be such that both A.C. and D.C. machines can be driven as generators, the former supplying the furnace, the latter the works.

The furnace has three upper arc-electrodes, and three supplementary electrodes forming a resistance-heating circuit in the base of the furnace. The former are supplied at a pressure of 108 volts, one electrode being connected to each of the three phases of the secondary of a 700-k.v.a. 2,825/108-volt three-phase transformer. A set of 18-volt tappings is provided, and is connected to the three supplementary electrodes in the base of the furnace. The current in this circuit attains a maximum of 8,000 amperes. A pressure regulator controlling the supply to the base electrodes is also provided. The electrodes are raised or lowered by mechanisms each coupled to a 2·2-kw. 108-volt three-phase motor, and these will be adapted later for use with the Cuénod automatic electrode regulator. The base electrodes, which are covered over with dolomite, are placed 60° (in a horizontal direction) to the arc electrodes in order to obtain a strong rotary force on the molten metal. Three doors are provided in the side of the furnace between the electrodes. The tipping mechanism is hydraulically driven.

Special provision is made to avoid heavy current fluctuations. The divided copper strips forming the leads to the arc electrodes are provided with iron spiral bands so as to reduce the rush of current due to short-circuits by means of the heavy induction drop in the circuit. The current in this circuit varies between 500 and 3,000 amperes. Further, the three-phase generator is designed for a particularly large pressure drop with increasing load, and the motor is compounded for a drop in speed, so that a heavy flow of current is accompanied by such a drop in speed and pressure as to keep the kw. output fairly constant. To intensify this effect and to limit the maximum demand, a Fuss regulator operated automatically by the variation in the motor current is provided. An increase in this current is caused by this apparatus to weaken the exciting field of the A.C. generator, and thus reduce the pressure.

These arrangements for avoiding heavy fluctuations cannot, of course, deal with a complete extinguishing of the arcs, but it was to avoid this complete loss of furnace load that the furnace described was chosen. The power taken by the base electrode circuit connected to the 18-volt tappings is anything from 15 to 40 per cent. of the total consumption of the furnace, according to the setting of the automatic pressure regulator. The usual setting is for the base electrode circuit to take 25 per cent. of the total power, and under this condition, if one of the three arc-electrodes falls out of action (which is the most frequent kind of disturbance), the input to the furnace falls to 80 per cent. of the normal. In general, a fluctuation of from 80 per cent. to 105 per cent. of the normal load has to be reckoned with. The base electrode circuit also tends to adjust automatically the input, as the current in this circuit varies with the square of the pressure, and so decreases rapidly when the pressure falls as the result of a heavy current flow into the arc circuit. *Vice versâ* with an open-arc circuit, as when the arc electrodes are raised up for the purpose of removing the slack, the power in the base electrode circuit rises from some 60 kw. to 160 kw.

The above arrangements have not only suppressed the usual fluctuations of the furnace demand, but have actually effected an equalising action on the central station load, and enable the turbine plant to be run continuously at full load and maximum efficiency. Any overload other than that from the furnace, and the consequent fall in pressure, results first in an increased current flow into the motor-generator set, but the compound winding on the motor quickly effects a drop in speed and A.C. pressure on the generator side, which in turn causes a drop in the power demand. If the motor current should reach the value limited by the Fuss regulator, the latter rapidly reduces the A.C. pressure, and thus further relieves the load on the system. A reverse action takes place if any considerable motor load is suddenly switched off.

ELECTRICAL MINING AND METALLURGICAL PATENTS PUBLISHED DURING MARCH

Mining.

In Specification No. 16,477/15, J. P. Forster describes apparatus for use in connection with mining signalling gear giving audible and visual indicators, whereby the giving of the "men to ride" signal on one of the main indicators effects the operation of an audible or visual indication which cannot be cancelled until the giving of a confirmatory signal on one of the remaining indicators.

Metallurgical.

In specification No. 4,081/18, M. Perreur Lloyd describes apparatus for the electrolytic production of zinc comprising an anode completely surrounding the rotary cylindrical cathode with the exception of an upper longitudinal space in which are mounted and reciprocate pads formed of skins parchmentised and insolubilised by immersion in aldehyde acetone or the like, these pads serving for wiping off bubbles of hydrogen that tend to be deposited on the surface of the cathode cylinder and resisting tendency to disaggregate to a dusty form, the result being to prevent the formation of a spongy or pulvurent deposit.

Another specification, No. 3,569/15, by C. E. S. Bell and L. G. Scott, describes an improvement in the electrolytic production of metallic type moulds, which consists in immersing the moulded plate as cathode in a current of electrolyte maintained at a high velocity whilst passing over the surface of the mould.

CONTROL EQUIPMENTS FOR WINDERS AND HOISTS

An excellent line of apparatus has recently been developed by the British Thomson-Houston Co., Ltd. (Rugby), for the control of motors used for winding and surface haulage in collieries. Each equipment consists of a drum-type master controller, a panel on which electrically-operated air-break contactor switches are mounted, and air-cooled resistances. We give illustrations below of panels for use with the rotor

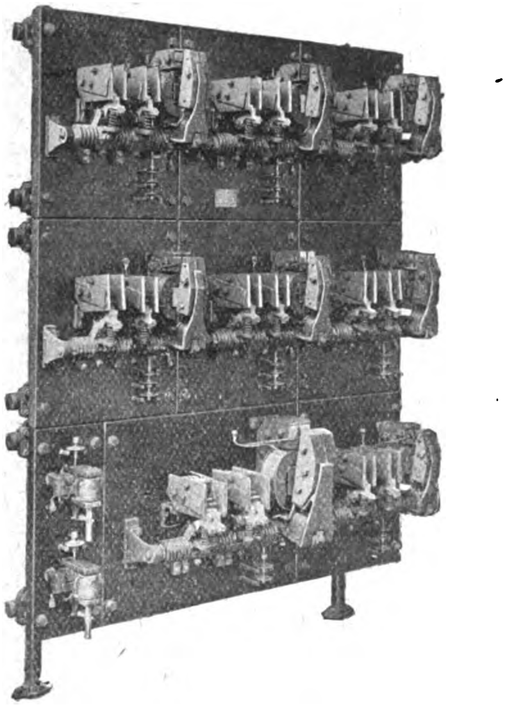

Fig. 1.—Contactor Panel for Rotor Circuit of 400-h.p. Induction Motor.

and stator circuits of large induction motors, and of one of the resistances. The latter consists of iron grids mounted on mica-insulated rods. The grids are insulated from each other and from the frame by pure mica washers. The motor can be started, stopped, and reversed by means of the master controller, which is of the B.T.-H. standard tramway type. This controller makes or breaks the circuit of the contactor switches, which then automatically control the current flowing

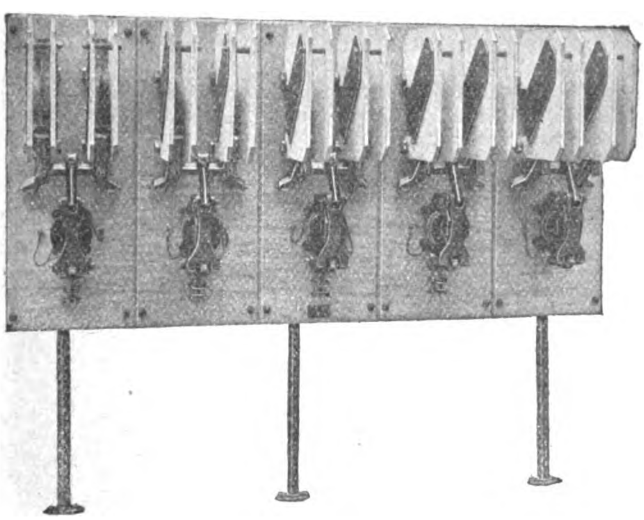

Fig. 2.—Contactor Panel for Reversing Stator Circuit of 3,300-volt Induction Motor.

to the motor independent of the operator. The closing of the contactors can only occur in the correct sequence, and each contactor remains open until the motor has accelerated sufficiently to permit additional resistance to be cut out of circuit without excessive current being taken from the line. Thus, even if the operator moves the control handle too quickly from the "off" position to the "full on" position, the current-limit relays on the contactor panel will automatically protect the motor against damage and permit it to be started up in the shortest time compatible with safety.

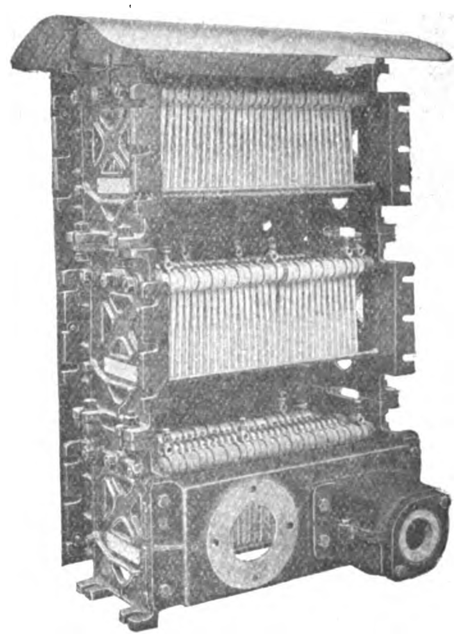

Fig. 3.—B.T.-H. Type C.G. Resistance, with Junction Box (Side Cover Removed).

This type of apparatus undoubtedly possesses many advantages over liquid controllers.

Crystal Palace School of Practical Engineering.—The 130th award of certificates takes place to-day. The school is about to be removed to more convenient premises close at hand, and this will be the last certificate distribution in the old south tower after 43 years.

ELECTRIC FURNACES IN THE LABORATORY

AN informal discussion on "Methods and Appliances for the Attainment of High Temperatures in the Laboratory" took place at a meeting of the Faraday Society on March 15th. The President, Sir Robert Hadfield, F.R.S., who was in the chair, referred to the difficulties experimenters used to labour under in trying to melt small quantities of metals like steel or copper in the laboratory before modern appliances, such as would be described by Dr. Harker, were devised. He went on to emphasise the importance of laboratory high-temperature furnaces in connection with the standardisation of pyrometric determinations, and he gave a short historical sketch of developments in pyrometry.

Dr. J. A. Harker, F.R.S., of the National Physical Laboratory, in opening the discussion, said his object was to draw attention to some of the more difficult points in this subject. He dealt almost exclusively with the carbon resistance furnace. The difficulty with this type of furnace was to obtain carbon of the proper qualities, and it was satisfactory to know that in this country the General Electric Company had a stock of carbon tubes for this purpose. Carbon for electric furnaces had a very variable specific resistance from one sample to another. Graphite had, roughly, one-fifth the specific resistance of carbon. For certain purposes when using graphite it was better not to make a plain, straight conductor, but to make it into a spiral or zig-zag. Provision had to be made for the carbon monoxide formed in the furnace to be quickly burnt. The material of which most tubes were made contained inorganic matter up to about 2½ per cent., whilst a thoroughly good specimen contained about ½ per cent. This could nearly all be burnt out by heating quickly to 1,800° or 1,900°. The need for completely enclosing the carbon furnace was very great, and at the National Physical Laboratory some years ago Mr. Eden built the walls of such a furnace of reinforced concrete, which was considerably better than bricks for preventing the carbon monoxide from getting into the atmosphere. In this new furnace, water cooling had been applied not only to the electrodes, but also to the ends, because the furnace was enclosed in an aluminium bomb arrangement, and the ends which were bolted on to the bomb were fastened by a packing ring which had to be kept cool.

The maintenance of the insulation of the carbon tube was important. One way was to have another tube round the carbon tube with an air space between, but for high-tension work this was thoroughly bad. He had found the simplest and best thing was to use the grade of lampblack used by paint makers, filling up all the space around the carbon tube for a radial distance of three inches. This had been found to be by far the most satisfactory material for ranges of temperature above 1,500 or 1,600.

Another point in connection with the new furnace was the important one of economy. It was necessary to obtain high temperatures with small power, and in order to get over this satisfactorily a small portable transformer had been made which could be used in the laboratory. There were 80 turns of primary made up in the simplest way and three secondary turns capable of being coupled in series or parallel. The primary was split so as to be used at 300 volts and downwards, and currents could be obtained up to about 1,000 amps. With the insulating soot which he had mentioned the one kilowatt which was necessary to maintain the temperature of 2,000° C. in the furnace only heated the outside wall to something over 100° C., so that there was no need for elaborate precautions. Messrs. Hadfield's were going to do with such a furnace just what had been done with it at the National Physical Laboratory, namely, standardise optical pyrometers. At the National Physical Laboratory there was a furnace like the one shown mounted beside a bench, on which all pyrometers for verification were put and slid along, the indications being compared with those of the standard.

Mr. R. S Whipple described some electric furnaces he had seen in America used for gear-hardening. Thermocouples passed through the furnace on to the work, which was simply brought up to the recalescent point, as indicated in a Northrup recording pyrometer, and then taken out and quenched.

Dr. W. Rosenhain, F.R.S., referred to some general difficulties in the use of high-temperature furnaces. One was the presence of carbon compounds; he wanted a furnace as tractable as Dr. Harker's, which would be free from carbon. On a small scale a tungsten wire vacuum furnace was effective, and he had melted pure iron (1,525 ± 5° C.) in such a furnace. But the tungsten became brittle and a fresh winding was necessary for each run. Granular tungsten resisters might be used, and so might a carbon resistance furnace with an inner tube, an indifferent gas between the two and a slightly oxidising gas in the inner space. The drop of volts between metal clamps and electrodes in electric furnaces became serious with large currents. He suggested coating the carbon with copper, aluminium, or iron, as the case might be, by the Schoop spray process, burnishing the coating to give a good metallic contact.

Mr. C. R. Darling remarked that the furnace first described would be very useful for laboratory purposes for melting small quantities of metals. He pointed out some of the drawbacks of platinum-wound furnaces. In furnaces of Dr. Harker's type he had found magnesia bricks satisfactory for outside lagging. Up to 1,000° C. furnaces wound with nickel-chrome wire gave good results. A furnace one foot long, using an inch tube, consumed only ½ kilowatt.

Mr. H. G. Lacell agreed as to the value of nickel-chrome winding. A kieselguhr tube wound with ribbon of this material could be rigged up in a few minutes. He had given up gas-heating for any temperature below 1,000° C.

Mr. H. A. Kent had been using a lime furnace for melting platinum and iridium, working beyond 3,000° C.; but he had recently obtained excellent results with a crucible of pure zirconia, using an oxy-hydrogen cyclone burner. He hoped it would be possible to make here pure zirconia in granular form; if so, almost any temperature could be obtained with surface combustion.

Dr. H. C. Greenwood thought there was nothing better than charcoal for insulating carbon-tube furnaces, and he held a brief for the rougher type of furnace built of bricks and charcoal. With regard to large furnaces, something was wanted between the arc furnace and the steel-melting furnace. He had melted 100 lb. of German silver at 1,200° in resistance furnace with a number of resisters in series.

Dr. W. Rosenhain remarked here that at the National Physical Laboratory they were experimenting with zirconia, and he hoped something would emerge that would be generally available.

Dr. J. A. Harker, in reply, said that until they had zirconia tubes alundum could be used as a substitute for carbon where that was unsuitable; but it was more expensive than carbon, and at present it was not gas-tight. He hoped the lampmakers would make squirted tungsten tubes, as they would be extremely useful. In his carbon-tube furnace, to prevent the soot from falling into the spiral groove it was only necessary to wrap filter paper round the tube. Its ash kept the soot from falling.

CORROSION OF CONDENSER TUBES

THE Institute of Metals a few years ago set up a Corrosion Committee to investigate the causes of corrosion in various non-ferrous metals. This experimental work has taken the form of laboratory experiments, and also experiments on a large scale, in which an endeavour has been made to reproduce practical conditions as far as possible. To some extent the work of the Committee has been handicapped by want of funds, but three very valuable reports have been issued. It is now pleasing to note that the Government has made a grant of £900 towards the work of the Committee, but the main point to which we wish to draw attention now is in connection with the third report, which was presented at the annual meeting of the Institute on Wednesday last week. During the past year the scope of the Committee has been widened so that, instead of consisting merely of representatives of the Institute of Metals, it now includes representatives of various other societies and bodies. The Institution of Electrical Engineers is represented by Mr. John Christie, Chief Electrical Engineer to the Brighton Corporation, who for some years has been experiencing considerable trouble from corrosion of the condenser tubes in his plant at the Southwick power-station. So serious had this become that the cost of replacing condenser tubes, which did not last for more than from twelve to eighteen months, amounted to £1,000 per year. It was necessary to call in expert chemical advice, and eventually an electrolytic method of preventing corrosion, invented by Mr. Elliot Cumberland, was adopted with completely satisfactory results, the cost of the current for working the process being one penny per day. This system, which is already doing good work on many of the White Star liners, &c., consists of a low-tension dynamo, generating current at a pressure of 6 to 10 volts, and pieces of iron are suspended in the water contained in the vessel to be protected and suitably insulated from it. The condenser itself is connected to the negative terminal and the iron anodes to the positive terminal of the generator. The common cause of failure of condenser tubes is galvanic action brought about in various ways, such as dissimilar metals in juxtaposition, the presence of carbonaceous matter in contact with the tubes, or difference of electrical potential, due to variations of temperature, &c. The object of the Cumberland process is to neutralise this action by introducing a superior electromotive force from an external source, which overcomes the minor destructive currents due to these adverse conditions, ensuring that the flow of current is always from the inserted electrode to the surface to be preserved. In practice one ampere per 500 sq. ft. is ample to afford complete protection. The system has been closely examined by professors at the Melbourne University, and these, together with users of it, including Mr. Christie, speak very highly of the results obtained. At Brighton a small polarised relay has been added to the equipment, which comes into operation in the event of a generator reversing its polarity.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,489.

I have a $1\frac{1}{2}$-h.p. shunt-wound 4-pole 100-volt motor that I wish to re-wind for a circuit of 500 volts. The armature is wave wound with a triplex winding, 29 slots, each slot containing two former wound elements, each element comprising three coils of four turns of No. 13 d.c.c. wire. The dimensions of the slot space occupied by the winding are 0·35″ × 0·832″. There are 87 commutator segments. Each field coil consists of 1,020 turns of No. 17 S.W.G., d.c.c. wire, and has a resistance of 8·62 ohms. It has been suggested that the armature should be re-wound "simplex." Give particulars of suitable windings for the field and armature, and state, if it is necessary to supply a new commutator, the least number of commutator segments necessary to obtain satisfactory working.—"CONVERTER."

(*Replies must be received not later than first post, Thursday, April 13th.*)

ANSWERS TO No. 1,487.

We have a synchronous motor-generator which we start up from the D.C. side and synchronise by means of a synchroscope. During some recent alterations to the three-phase supply cables on the roof the phases were crossed, with the result that, when we tried to synchronise soon afterwards, the circuit-breaker came out with a terrific kick, though the machines were apparently in synchronism. Is there any method of ascertaining that all is well on the A.C. side, so that this trouble may be avoided in the future?—ATTENDANT.

The first award (10s.) is made to "E. H." for the following reply:—

Most types of synchroscopes for three-phase systems are arranged to work off a pair of the switchboard 'bus-bars and the corresponding pair of leads from the incoming alternator. When an alternator is run for the first time, tests must be made to determine the bar to which its leads are to be connected; and all that is afterwards necessary is to synchronise on one phase, since the other phases will then be automatically in synchronism. When any alterations have been made to the alternator cables, the three phases must be tested over again. The simplest method of doing this is to bridge across one of the switches by means of a temporary lead and to connect two voltmeters, one across each of the other switches. The alternator is run up until its voltage and frequency are the same as those of the 'bus-bars. The equality of the frequency is indicated by the slow oscillation of the voltmeter pointers between zero and a maximum. If the alternator leads do not correspond to the 'bus-bars to which they are connected, then the two voltmeters do not give a zero reading simultaneously. This means that at the instant when two of the phases appear to be in synchronism there is a large voltage across the other switch. This was the cause of the trouble experienced by "Attendant." Any two of the alternator cables should be changed over, and it will be found that the voltmeter pointers move in synchronism. When they indicate zero, the switches are closed.

If the system is a low-tension one, it may be found more convenient to use a number of lamps in series instead of the voltmeters. It must be borne in mind, however, that the maximum voltage across the switches when the machine is out of phase is twice the line voltage.

Again, if the star-point of the alternator happens to be earthed or joined to the star-points of the other alternators, either it must be disconnected before bridging over one of the switches, or a third voltmeter or a third set of lamps must be used instead of the temporary connection across that switch.

The second award (5s.) is made to "Y. Z." for the following:—

A good deal is left to the imagination of the person who answers this question, as no indication is given either of the exact type of synchroscope, or of the exact part of the system to which it is connected. Apparently, the trouble is due to the particular synchroscope here used not being connected sufficiently near to the points which are actually going to be directly connected together finally on synchronising. If, for example, one side of the synchroscope be coupled direct to the bus-bars of the supply, and the other side is coupled to the terminals of the synchronous motor, then the synchroscope will indicate, and that quite correctly, when the two points to which it is connected are capable of being connected together, the phases being, of course, joined together on the mains in a way corresponding to the manner in which the synchroscope is coupled up to one or more of the phases of the circuits to be synchronised. The last clause of the preceding sentence probably gives the necessary clue to the cause of the trouble which has been experienced. The synchroscope only indicates when there is a certain relation between two points on the system to which it is connected, and the indication requires interpretation. That is, when first installed, with the cables in a certain way, it was correct to close the main switch joining the motor to the supply when the synchroscope gave a certain indication. If, however, the cables have been changed over as described, which, of course, reverses the order of successive maxima at the terminals, and if, in making this change in the cables, the synchroniser has been left exactly as before, and has not been also correspondingly changed over, it will no longer be correct to close the main switch for the same indication on the synchroscope, because the whole of the relations in the circuit have been vitally changed; but the synchroscope is not in a position to take any note of the change. If, however, the synchroscope be connected to the actual points which are going to be joined together, either directly or through some switchboard connection, which is rigid and fixed, and cannot be altered, instead of through cables, which are flexible and movable, and can be altered, then, should such a change as the question describes occur again, the synchroscope would certainly be changed over too, and would show, by the changed character of its indications, that something was wrong. Whether it would be obvious what had happened exactly would depend on the nature of the change and the type of synchroscope employed; but in all ordinary cases attention would be drawn to the fact that something in the circuit was abnormal. Therefore, by coupling the synchroscope to the circuit in such a way that any change in the connections of the circuit will cause a change in the way in which the synchroscope is connected to the vital point of it, it is possible, as the question requires, to ascertain that—in respect of synchronism only, of course—all is well on the A.C. side, and so the trouble will be avoided in future.

The Institution and its Alien Members.—The Birmingham Local Section of the Institution has had under very careful consideration the question of alien membership. After a full discussion on the matter at two meetings, the Committee unanimously passed the following resolutions, which have been sent to the Council:—

(1) That the Council be requested to obtain powers to amend the Articles of Association to exclude from membership of the Institution any undesirable aliens or undesirable members of alien origin.

(2) That in view of the foregoing resolution it is not considered necessary to proceed with the resolutions at present before the Institution.

Electricity Works Controlled Establishments.—With reference to our recent note on this subject, an interesting case arose at Manchester last week, when a labourer in the fitting-shop at one of the power stations asked for release on the ground that he could be more usefully employed at his own work as a filler in a coal-mine. He said he had been offered 9s. 2d. a day, whereas he was only getting 28s. a week as a Corporation labourer. The Electricity Department, however, resisted the application on the ground that the applicant was skilled at his work and would be difficult to replace. Moreover, it was said that he could earn considerably more if he did not do so much "slacking." The application was refused, but a fitter who had been offered a place in a munition works was granted release from Corporation employ on promising to produce the letter confirming the offer mentioned

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published March 30th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

21,992/14. **Protective System.** M. Hochstädter. A system of automatically isolating faulty sections of an A.C. distributing network in which the main and protective conductors are in metallic contact at both ends, and there is maintained between them uninterruptedly during normal working a small but determinate difference of potential due to the inductive influence of the main on the protective conductor. The ends of the protective conductor are connected through the windings of the protective relays that actuate the circuit-breakers in the main circuit. (Four figures.)

3,410/15. **Lamp Exhausting.** B.T.-H. Co. (*G.E. Co., U.S.A.*) An exhausting machine for lamp bulbs with a rotary carrier for the bulbs, a final pump rotatable with the carrier, and a stationary rough pump. Means are provided for automatically connecting the bulbs first to the rough pump and then to the final pump during the rotation of the carrier. A heater is provided in the form of a hood lowered over the bulbs during exhaustion. (Three figures.)

3,953/15. **Fixation of Nitrogen.** E. K. Scott and F. Howles. An arc furnace for fixation of atmospheric nitrogen with electrodes with shield-like ends enclosing a central space in the form of an inverted cone, with arcing gaps between adjacent electrodes and baffles or partitions closing the space between the walls of the furnace and the tops of the electrodes, the inlets being arranged so that the air passes from outside the electrodes through the arcing gaps to the enclosed space. (Five figures.)

3,954/15. **Wireless Telegraphy.** Naamlooze Vennootschap de Nederlandshe Thermo-Telephoon Maatschappij. A system of wireless telegraphy or telephony employing a thermal telephone as detector or receiver. (Two figures.)

11,511/15. **Primary Batteries.** J. T. Fahy and A. E. Otway. A method of resuscitating exhausted porous pots of Leclanché cells by introducing hydrochloric acid through a special funnel. (Two figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Dynamos, Motors and Transformers: Schöngut [Armature winding] 3,932/15; Walker [Rotary converters] 4,401/15; Rosenberg [Equalising windings] 6,723/15; Emie Haefeley et Cie [Vacuum impregnating apparatus] 10,803/15.

Electrometallurgy and Electrochemistry: Nathusius and Westdeutche Thomas-phospat-werke Ges. [Electric furnaces] 13,951/14.

Heating and Cooking: Berry [Radiators] 24,170/14; Railing and Ide [Electric soldering irons] 7,492/14.

Ignition: Hurst and Mills [Sparking plugs] 24,644/14; Melsome-Smith [Magneto for ignition, lighting, and charging] 247/15; Lister, Watson and M.-L. Magneto Syndicate, Ltd. [Magnetos] 3,882/15; Standard Co. [Stationary igniter electrode] 13,754/15; Harley [Ignition apparatus] 16,233/15.

Incandescent Lamps: Harrison [Incandescent lamps] 3,949/15.

Instruments and Meters: Sharman [Localiser of conductors] 24,056/14; Landis & Gyr A.C. [Measuring instruments] 3,856/15.

Switchgear, Fuses, and Fittings: Holt and Smith [Oil circuit breakers] 4,144/15; B.T.-H. Co. and Wedmore [Protective devices] 4,432/15; Rudd [Lamp lock] 5,628/15; Markt [Switch terminal] 15,989/15; British Westinghouse Elect. & Mnf. Co. [Electrically controlled circuit breakers] 17,690/15.

Telephony and Telegraphy: De Forest and Logwood [Wireless receiving apparatus] 3,950/15; Baronio and Wood [Automatic telegraph transmitters] 5,017/15; North [Field telephones and telegraphs] 8,358/15.

Miscellaneous: Sterling Telephone & Electric Co., Bell and Barclay [Step by step signalling apparatus] 3,841/15; Wade (*Leeson*) [Coil winding] 4,229/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [X-ray apparatus] 4,928/15; F. P. Baumann [Dry battery] 2,056/16 (*100,086*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Electrometallurgy: Deutsche Gold und Silber Scheideanstalt vorm. Rössler [Manufacture of sodium perborate] 3,084, 3,127, & 3,184/16 (*100,152, 100,153, & 100,154*).

Telephony: Naamlooze Vennootschap de Nederlandshe Thermo-Telephoon Maatschappij [Thermic telephones] 5,843 & 5,844/15; Signal Ges. [Multiple contact microphones] 3,533/16 (*100,156*).

Miscellaneous: G. Giles [Electrolytic condenser] 3,534/16 (*100,152*).

Amendment allowed

22,757/14. **Insulators.** H. L. Doulton and W. Podmore. Leave has been granted for certain verbal alterations to be made in this specification, which describes a machine for shaping porcelain insulators.

Opposition to Grant of Patents

24,293/14. **Engine-starting Motor.** A. H. Midgley and C. A. Vandervell. An appeal has been lodged against the decision of the Comptroller, allowing the grant of a patent on this application, which relates to motors for starting automobile engines, with an arrangement for drawing the pinion into mesh by a longitudinal movement of the armature.

Suspension of Enemy Patents

14,082/08 and 29,230/11, **Magnetic Separators,** G. Ullrich, and 4,595/13, F. Krupp A.G. Grusonwerk. An application of the Rapid Magnetting Machine Co. (Birmingham) for the suspension of these patents, all of which relate to magnetic ore and other separators, will be heard by the Comptroller to-morrow.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

8,558/02. **Train Control.** B.T.-H. Co. (*J. B. Linn*). A multiple unit train control system with electromagnetic contractor arranged for automatic acceleration.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: Mavor & Coulson and H. A. Mavor [Induction motor drive with primary and secondary members geared together by variable-speed gearing] 27,100/04.

Electrometallurgy and Electrochemistry: P. Garuti and C. R. Pompili [Electrolytic production of oxygen and hydrogen] 27,249/03.

Incandescent Lamps: C. Pauli [Resilient mounting of metal filaments] 27,541/07 and 6,409/08.

Traction: W. P. Thompson (*C. Berg*) [Driving mechanism for electric vehicles with all four wheels driven by separate motors] 27,810/02.

Miscellaneous: Otis Elevator Co. (*Otis Elevator Co., U.S.A.*) [Ammunition hoists] 29,132/09.

Germany's Shortage of Copper.—Although the German Institution of Electrical Engineers (Verband Deutscher Elektrotechniker) prepared most careful standards for iron-wire "flex" and fittings wire to replace copper, it appears that these were hardly used at all. "Contrary to expectation," says an official memorandum of the Verband, "it has been found possible to make efficient substitutes with aluminium and zinc wire, and standards are now issued for these. It is also interesting to note that cables insulated with reclaimed rubber (and there are now no other rubber-insulated cables made in Germany) are to contain a distinguishing thread of light green colour. We advise our readers to look out for this under the braiding of any cable of which they may feel suspicious in the future. Owing to the shortage of lead, new standards for lead-covered cables within thinner lead sheaths than were formerly permissible have now been issued.

The Business Side of Science.—Continuing his campaign on behalf of the British Electrical and Allied Manufacturers' Association in favour of steps being taken at once to prepare for a possible coming economic crisis, Mr. T. C. Elder will read a Paper on "The Business Side of Science" at the North-East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle-on-Tyne, to-morrow, Friday. In this address Mr. Elder sets forth views he has expressed on several previous occasions, and with which our readers are now quite familiar.

WITH THE MECHANICAL TRANSPORT IN ALEXANDRIA

THE following is an extract from a letter received from Lieut. A. R. Courtenay, who, before taking up his commission, was Acting Publicity Manager to the General Electric Co., Ltd. Writing, on active service with the Mechanical Transport (M.T.), A.S.C., from Alexandria, he says:—

"I am with a splendid company. We run our own pierrot concert party, which has become very famous, the zenith of our fame being reached recently when we gave a concert at the Alhambra Theatre in aid of the United Services Recreation Fund. A week before, our name was practically unknown, but on the night of the show we had a record full house and took over £100.

"Being responsible for the publicity work, I was thoroughly

in my element. Within forty-eight hours of being told to "carry on," I had the town painted green with posters, nearly a thousand of which were distributed to all the principal shops in the town and district. These were backed up by 5,000 small handbills and a large quantity of small invitation tickets.

"The stunt, however, was my troupe of Arab sandwichmen, a method of publicity which had never been seen before in Alexandria. I had fourteen in all, divided into two groups, one group having the letters EMPTIES on their front board and a poster on their back, and the other group *vice versâ*. Being quite unable to read English characters, they did not at first appreciate the importance of keeping their places, hence the letters showed an inclination to wander at times until I had drilled them. Their appearance caused endless amusement, not only amongst themselves, but throughout the town generally.

"Considering there are no English compositors here, the printed matter was turned out very creditably."

High-speed Machinery for Collieries.—A useful Paper on "Hints on the Installing, Erecting, and Starting-up of High-speed Machinery" was read before the Association of Mining Electrical Engineers at Wakefield, on Saturday, March 25th, by Mr. J. A. McLay. The author said he had found that many troubles which had developed in connection with high-speed machinery were due to defective erection on site or starting-up. He considered it advisable always to submit the plans for erection to the manufacturers of the plant. The four points which settled practically the satisfactory working of any high-speed machine were (1) foundations and grouting-up, (2) level and alignment, (3) coupling, (4) connections, and they were all of equal importance. Standard high-speed machines, such as turbine pumps, fans, motors, &c., were designed to be mounted on solid foundations of concrete, brickwork, masonry or steel construction, and they should not be set up on temporary foundations, such as timber, without first consulting the makers.

No Potatoes: No Light!—A shortage of potatoes is said to have been the cause of a long interruption to the electricity supply of the small towns of Boldixum and Wyk, Föhr, Silesia. It appears that the allotted portion of potatoes had been ordered by the municipality of Boldixum, but were not forthcoming, and that the engineer in charge of the small central station supplying the two communities was in particular much annoyed at this delay. One day, when his patience had become exhausted, he categorically announced that if his share of potatoes did not arrive at a certain time that evening there would be no more light. The potatoes did not arrive, and, true to his word, and to the utter dismay of the inhabitants, this starved and desperate engineer suddenly shut off the supply to both towns. Anger and threats proving useless, the inhabitants eventually collected the few treasured potatoes still remaining and sent them, together with a present of some eggs, to the triumphant engineer, who then started up the plant again and switched on. So at least it is written in a recent issue of the *Frankfurter Zeitung*.

THE I.M.E.A. ANNUAL MEETING

THE preliminary programme of the annual meeting of the Incorporated Municipal Electrical Association, which, as we have already announced, will be held in London on June 22nd and 23rd, has now been issued. The meeting on both days will be held at the Institution of Electrical Engineers, Victoria Embankment. On Thursday, June 22nd, at 10 a.m., the Presidential Address by Mr. A. C. Cramb (Chief Electrical Engineer, Croydon) will be followed by a Paper on "Boiler-house Design," by W. W. Lackie (Chief Electrical Engineer, Glasgow). There will be an adjournment at 1 o'clock, and in the afternoon Papers on "Area of Supply from an Economic Standpoint," by H. S. Ellis (Chief Electrical Engineer, South Shields), and "The Application of Electric Power to Agriculture," by W. T. Kerr (Chief Electrical Engineer, Hereford), will be presented.

The business meeting will be held on Friday, June 23rd, at 10.30 a.m.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

Presiding at the annual meeting of the Automatic Telephone Manufacturing Co. last week, Mr. Thomas Taylor, the Chairman, said that for some time past the resources of the Company had been almost entirely devoted to important war work. There had, however, been completed during the year automatic telephone exchanges at Rosario (Argentine), Newport (Mon.), Accrington, and Chepstow, as well as several smaller but important exchanges. The Company has in hand important automatic exchanges at Portsmouth, Paisley, Leeds, and Blackburn, all of which are in an advanced state, although there has been delay owing to enlistments. Whilst the opening of the Leeds exchange might be further delayed through a large extension, it was hoped that the other three would be put into operation this year.

A circular to shareholders of Marconi's Wireless Telegraph Co. states that Mr. Marconi has been engaged on important research work in Italy which has resulted in far-reaching effects. As a consequence, applications are being made for a number of patents which will probably be applied at once in Italy for military purposes.

CATALOGUES, PAMPHLETS, &c., RECEIVED

VACUUM CLEANERS.—A new list by Drake & Gorham, Ltd. (1 Felix Street, Westminster Bridge Road, S.E.), describes electric vacuum cleaners of various types and sizes, designed for private residences as well as large establishments. The motors for some of the cleaners are made to run on either A.C. or D.C.

ELECTRIC LIGHT FITTINGS AND ACCESSORIES.—A leaflet issued by Julius Sax & Co., Ltd. (24A High Street, New Oxford Street, W.C.), illustrates a number of useful lighting accessories, including lampholders, wall plugs, bells, indicators, &c.

Readers desiring copies of catalogues or pamphlets should apply to the firms in question, referring to the notice in "Electrical Engineering."

ELECTRIC MOTORS.—We have received from the Swedish General Electric, Ltd. (Canada House, Kingsway, W.C.), stock lists of their A.C. and D.C. motors. The former includes single-phase motors from ¼ h.p. to 20 h.p.; three-phase, 50 cycle. motors from ¼ h.p. to 125 h.p., and 25 cycle, to 30 h.p., as well as two-phase, from ½ h.p. to 10 h.p. The D.C. machines are for voltages of 110, 220, and 440, and of all sizes up to 50 h.p.

Fires from Electrical Causes.—Dr. F. J. Waldo, the City Coroner, has something to say in his Annual Return for 1915 under the City of London Fire Inquests Act with regard to fires which have been traced to electrical causes. Under this Act inquests on fire are held even though there are no actual fatalities involved, and in the case of 26 fires as against 11 in 1914, the Coroner has, with the assistance of the City Electrical Engineer, been able to decide that they were due to defective electrical arrangements.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION

THE National Electric Light Association, of the United States of America, holds a yearly Convention. Last year's meeting was held in San Francisco, from June 7th to 11th, and is duly reported, as usual, in four large bound volumes which have just been issued. The first of these deals with the "General Session," and the most important item of its contents to the non-member is an excellent Report of the Committee of Progress. This covers, in its 134 pages, the whole field of electrical progress of interest to electricity supply men during the year—lighting, power, steel-works, electric vehicles, heating and cooking, and even electrical egg production—giving detailed quantitative and technical information, and not merely statistics. For instance, it deals with the advantages of electrically-heated pots for type-setting machines, and tells how the *New York World* replaced their former electrically-heated ones (which had displaced gas-heating in 1909) with a new set employing electric immersion heaters on 56 machines, and has thereby saved 40 per cent. in current, and improved the quality of the work. The method of speeding up of egg-laying in winter by lighting the coops in the evening, and resulting in a five-fold increase of eggs during the moulting season, is quite seriously explained.

There are no fewer than 31 Standing Committees of the Association, and a great part of the second volume is taken up with the reports of the technical ones of these. The Committee on Electrical Apparatus covers a wide ground. Among the things mentioned are portable sub-stations, and a photograph is given of a 3,000 K.V.A. sub-station built on a railway truck and capable of dealing with primary voltages of up to 100,000. This has only static transformers, but another, also illustrated and briefly described, receives current at 44,000 volts 3-phase, and supplies at 1,500 volt D.C. for an electric railway. Remote control sub-stations, synchronous condensers, and large mercury vapour rectifiers have brief sections devoted to them, and a "switchboard manual," describing current practice and well-illustrated with diagrams, occupies 38 pages.

A Paper on the "Diversity Factor," by Mr. H. B. Gear, is chiefly interesting for the following two very stiff definitions, the first of which, it is stated, is similar to the one adopted by the International Electrotechnical Committee, and is approved by the National Electric Light Association's Committee on Terminology.

"Diversity factor is the ratio of the sum of the maximum power demands of the subdivisions of any system or part of a system to the maximum demand of the whole system or part of the system under consideration, measured at the point of supply."

"Individual diversity factor is the ratio of the maximum power demand made by any subdivision of a system or part of a system to the coincident demand made by such subdivision at the hour of the maximum load upon the whole system or part of the system under consideration."

The Committee on Terminology reports at some length altogether. "Protective Reactor" is given as the term to use for a resistance coil employed for protective purposes, and we are rather surprised to see definitions of "a synchronous converter, sometimes called a rotary converter," and a "phase modifier, also called a phase advancer." Surely the latter of the two alternatives in each case hardly requires new names now. Nor do we particularly approve of "A resister is a device, heretofore commonly known as a resistance. . . ." We shall continue to call the device resistance, even at the risk of our American friends calling us common. Electro-static capacity, it is recommended, should henceforth be called capacitance! The report concludes with an attempt to define the difference between a reflector, shade, and globe, apparently in such a way as to leave the American illuminating engineer to use these terms to a certain extent indiscriminately for the same thing as he does at present. The whole report, resister, capacitance, and all, was accepted without discussion.

Space does not permit us to review in detail the excellent collection of Papers and Report on hydro-electric plants and transmission problems, or the shorter ones on street lighting, underground construction, and accident prevention.

In the volume dealing with commercial matters it is interesting to see to what extent lamp sales in America are under the control of the National Electric Light Association. The supply companies affiliated to it accounted for the sale of only slightly under 100 million lamps for domestic purposes during 1914. A table is given showing the relative sales of different classes of lamps since 1907, and we quote four typical years below, giving the various classes as percentages of the total sold :—

Type	1907.	1910.	1912.	1914.
Carbon	93·27	63·08	25·47	7·11
Gem	5·88	14·88	33·59	22·36
Tantalum	0·75	3·57	1·00	—
Mazda	0·10	18·47	39·94	70·53

The report also quotes a popular, but not too inaccurate, explanation of the effect of nitrogen in the lamp known as the "half-watt" lamp in this country :—

"First, it makes a pressure in the bulb—a gas pressure—similar to steam pressure in a boiler. This pressure raises the evaporating or boiling temperature of tungsten, just as pressure in a boiler raises the boiling temperature of water. As boiling or evaporating is the cause of the wasting away of the tungsten filament, the pressure of the nitrogen permits the operation of the filament at a much higher temperature and higher efficiency than is possible in a vacuum, the rate of evaporation being the same in both cases.

"Secondly, the nitrogen conducts heat away from the filament; this cools the filament—wastes energy—and this effect of nitrogen is bad.

"The first effect of nitrogen, however, is so great that it overcomes the bad effect, and has enough good left to its credit to produce the great improvement realised."

The fourth volume of the Report deals with the supply station accounts and accounting.

THE GOVERNMENT PRESCRIBES EFFICIENT LIGHTING

(*Communicated.*)

IT had been urged for a considerable time prior to August 4th, 1914, by a few far-seeing illuminating engineers that our lighting methods were, in the majority of cases, very wasteful. These engineers now have the satisfaction of knowing that the principles laid down by them in the face of active and passive conservatism are the correct principles on which lighting should be carried out, and, moreover, that the lighting regulations which have had to be enforced by the Government for our safety are based on these principles. One, of paramount importance, is the necessity for controlling the direction in which a light source throws its beams so that waste be prevented. This is obviously true, but it is surprising how seldom this has been acted on. If we take any case—domestic, shop, or industrial—we realise that in each a small, cheap, efficient, and adaptable light source would prove of much value. In particular, where a concentrated light is required over, say, writing desks, billiard tables, machine tools, fitting benches in munition works and other engineering factories, typewriting offices, drawing offices, shop windows, showcases, staircases, passages, as well as for such delicate work as falls to the lot of the optician, jeweller, watch and clock maker, &c., a special lamp has been perfected at the Osram-Robertson Lamp Works (Hammersmith), and is known to the public as the Osram "Axial" type lamp. In appearance it differs from the standard Osram, having a so-called pear-shaped bulb, in that it has a larger diameter, but is more squat. By this means it is possible to arrange the filament, consisting of pure drawn tungsten wire wound into a helix of very small diameter, into a comparatively small space so that the light is, to a great extent, thrown downwards instead of sideways, as in the case of the ordinary tungsten lamp.

OSRAM "AXIAL" TYPE LAMP FOR DOWNWARD ILLUMINATION.

It will, of course, be understood that the Osram "Axial" type lamp is not meant to replace the standard Osram lamp, although there are many positions where its use would be distinctly advantageous. By means of a conical opal reflector, which is made to fit closely to the upper half of the bulb, any rays of light which would otherwise be lost in the upward direction are reflected downwards, thereby increasing the candle-power in the direction required by nearly a hundred per cent. As with all Osrams, the efficiency and life of Osram "Axial" type lamps are extremely high.

Full particulars and any information respecting lighting problems will be willingly given by the General Electric Co., Ltd. (Illuminating Engineering Dept., 67 Queen Victoria Street, London, E.C.), to all who are desirous of obtaining the utmost commercial efficiency from their establishments.

Breakdown on the London Underground Railways.—On Friday evening, at about 6.15, a high-tension feeder close to Lots Road Station developed a serious earth. It tripped its circuit-breaker, and the surge caused by the fault led to the circuit-breakers of other sub-station feeders being brought out also. There was, in consequence, a partial interruption of the service, but the supply of the service to all the lines was completely restored by 6.50 p.m.

LOCAL NOTES

Dartford: *Electricity Deficit.*—The outstanding deficit of £4,000 on the working of the electricity undertaking has been the subject of a special debate in the Council. The real reason for the position seems to be the unexpected increase in the price of coal, to counterbalance which there has been no increase in charge. An increase of 20 per cent. in the charges has now been sanctioned by the Council.

Dundee: *Wiremen's Wages.*—An arbitration recently took place concerning an application for increased wages by the local wiremen. The present rate is 9d. per hour, and a 2d. advance is demanded. The arbitration award will be published in due course.

Edinburgh: *The New Power Station.*—The long fight which centred around the proposal to erect the large new power station at Portobello has culminated in something of a success for the advocates of it, for it is announced that the application for current received from one firm alone will give a profit sufficient to meet the capital charges upon the expenditure on the first section.

London: *City Lighting Charges.*—The proposal of the Charing Cross, West End & City Electricity Supply Co. to apply to the Board of Trade for an increase in the maximum lighting charge in the City of London from 5d. to 5½d. per unit during the period of the war and for twelve months afterwards is to be opposed by the City Corporation when it comes before the Board of Trade.

Marylebone.—The estimates for the electrical undertaking for the year to March 31st, 1917, are that there will be a total output of 15·9 million units, included in which is an additional 300,000 units for heating and cooking purposes. The average receipt per unit is put at 2·8d., and the total revenue at £218,795. After making provision for capital charges, the expenditure is put at £215,862, leaving £2,933 net profit. It is pointed out that the average price for coal is about 67 per cent. above that paid at the beginning of 1915. The Sales Department is estimated to give a credit balance of £330 instead of a debit of £2,000 or £3,000 as hitherto.

Manchester: *Power Contracts.*—Councillor Ross Clyne proposes to call attention to the fact that a request made to the Electricity Committee for large supplies of current by a firm intending to contract with the Government for a product of great importance, to be supplied from a new works in Manchester, was not brought before the Committee as a whole for consideration. He suggests that in future all important proposals of this nature should be submitted to the Committee before acceptance or refusal.

APPOINTMENTS AND PERSONAL NOTES

The salary of Mr. T. R. Whitehead, Engineer and Manager of the Coventry Corporation Tramways, is to be increased from £500 to £600 per annum.

The War Department, Southern Command, have a vacancy for a Station Engineer. (See advertisement on another page.)

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £135 to £137 (last week the same).

Bankruptcy.—At the Bristol County Court last week Mr. G. J. Parfitt, Consulting Electrical Engineer, of Keynsham, applied for his discharge in bankruptcy. The failure is attributed to giving guarantees to the Bristol International Exhibition and to loss of business caused by the war. The liabilities are expected to amount to £3,119, and the assets have realised £97. The discharge was suspended for two years.

Proctor's Tables and Discount Book.—We have received from Messrs Edward le Bas & Co. (Dock House, Billiter Street, London) a copy of "Practor's Useful Tables and Discount Book." In size it is very convenient for the waistcoat pocket, whilst its contents contain a number of features not found in ordinary discount books. We understand that a limited number are available at 6d. each or 4s. per dozen, although the usual price is one shilling per copy.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The specification and form of tender for sixteen 1,600-volt direct-current motors, with field rheostats and accessories, for the New South Wales Government Railways & Tramways Stores, may be seen at 73 Basinghall Street. Alternative tenders are required for motors fitted with interpole windings. Local representation is necessary.

Pembroke.—A loan of £10,450 was recently sanctioned, and the Electricity Department is contemplating ordering new machinery.

Salford.—Three-phase extra-high-pressure and low-pressure switchgear for 5,000-kw. sub-station. Borough Electrical Engineer. April 17th. (See an advertisement on another page.)

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

W. T. Henley's Telegraph Works.—At the annual meeting on Wednesday, last week, Mr. George Sutton, the managing director, stated that one of the changes brought about by the war was the reduction in the home demand and the inability to meet the greatly increased demand from neutral countries. He did not agree, however, that the company was losing goodwill thereby. The increase in the profit for the past year—namely, from £119,000 to £161,000—was due to two causes. First, the company's large purchases of copper, rubber, and lead had brought in considerable profits owing to the increase in price of these, and, secondly, increased turn-over. In order to overcome the uncertainty of getting deliveries of small sizes of copper wire, not hitherto made by the company, a small factory in Yorkshire has been acquired. After the war Mr. Sutton thinks there will be a severe struggle for business, which will probably mean cutting of prices owing to the large increase in cable-making machinery which has been installed to meet the war demands.

British Insulated & Helsby Cables.—At the annual meeting last week attention was called to the fact that the profit of £295,131 shows an increase of £17,703 over the previous year, and was more than the company had made in any previous year. Apart from being a "controlled establishment," and producing Government war orders, the company had done an increasing business with the Government in the ordinary lines of manufacture. Further, at the special request of the Government, several new lines of manufacture had been undertaken which gave promise of remunerative results when normal conditions again prevailed. In addition to all this, the company had met the demands of home and Colonial trade to the best of their ability, and, lastly, had endeavoured to obtain foreign business in the open markets with considerable success. A shareholder called attention to the fact that there are no fewer than five different reserve funds of the company, and suggested that larger dividends might be paid. The chairman said this point would be taken into consideration in the future if profits still continued.

British Westinghouse Co., Ltd.—The net profit for 1915 amounted to £176,752, to which is added £8,121 brought forward. Patents, goodwill, &c., are written off to the extent of £25,000; special depreciation of plant, machinery, &c., absorbs £35,241; reserve for employers' liability, £5,000; and after paying 7½ per cent. on the preference shares there is a carry forward of £44,632. The works are a "controlled establishment," and the large carry forward is in view of possible liabilities for taxation of excess profits.

Brompton and Kensington Electricity Supply Co.—At the meeting on Monday it was stated that it was only possible to declare the usual dividend of 10 per cent. for 1915, because the Company's resources have been husbanded in the past, with the result that more than half the capital is represented by mains, the reserves of profits amount to 60 per cent. of the capital invested in the business, there is no debenture debt, and there are still fifteen years of tenure to run. If, however, the profits remain at the present level, the present rate could not be maintained. The Accessories Company continues to do good business and the restaurant is now self-supporting.

TRADES DIRECTORY OF
ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Poulton Bros., Ltd., 38 and 39, Cowcross St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

COMMUTATOR CEMENT.
Godfrey & Co., 54, Lower Thames St., E.C.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

FLEXIBLE METALLIC TUBING.
United Flexible Metallic Tubing Co., Ltd., 112, Queen Vict. St., E.C.

HEATING AND COOKING APPARATUS.
Belling & Co., Derby Rd., Edmonton, N.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electrical Trading Co., Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd, 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Record Electrical Co., Ltd., Caxton House, Westminster. S.W.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Phœnix House, King William St., E.C.

LADDERS.
Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.

LAMPS (Incandescent)—*contd.*
General Electric Co,, Ltd., 67, Queen Victoria St., E.C.
London & Rugby Engineering Co.. Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

MOTORS AND DYNAMOS.
British Thomson-Houston Co.. Ltd., Rugby.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons, Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

RUBBER GLOVES.
Ingram (J. G.) & Son, Hackney Wick, N.E.
Moseley (D.) & Sons, Ltd., Ardwick, Manchester.

STEAM ENGINES AND TURBINES.
Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk St., W.C.
Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
United States Metallic Packing Co., Ltd., Bradford.

SWITCHGEAR.
British Thomson-Houston Co., Ltd., Rugby.
Dorman & Smith, Ltd., Ordsal Electrical Works, Salford.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Electric Control, Ltd., 177, Reid St., Bridgeton, Glasgow.
Ellison (George), Warstone Lane, Birmingham.
Ferranti Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Igranic Electric Co., Ltd., 147, Queen Victoria St., E.C.
Record Electrical Co., Ltd., Caxton House, Westminster, S.W.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.

TECHNICAL BOOKS.
Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
Constable (Archibald) & Co., Ltd., 10, Orange St., Haymarket, W.
Crosby Lockwood & Son, 7, Stationers' Hall Court, E.C.
Macmillan & Co., Ltd., St. Martin's Street, W.C.

TELEPHONES.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Graham (Alfred) & Co., St. Andrew's Works, Crofton Park, S.E.
Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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SUMMARY

The establishment of a national laboratory for scientific research in connection with the needs of British industries was advocated by Mr. A. P. M. Fleming, in an address to the Manchester Engineers' Club on April 4th (p. 130).

Useful curves for calculating the skin effect in wires and strap conductors have been published by Mr. H. B. Dwight (p. 130).

A concise account of methods of testing transformer oils, recommended by the Research Committee of the Institution of Electrical Engineers, is published in the Institution *Journal*. Detailed methods of investigation are given for testing oils in respect of twelve different characteristics (p. 131).

A form of 11,000-volt cable junction box used for service connection to ring mains was described in a Paper by Mr. D. M. Macleod before the Scottish Section of the Institution of Electrical Engineers last Tuesday (p. 131).

An example of church lighting, showing the excellent effects obtained by the use of concealed trough reflectors, is described in an illustrated article (p. 132).

A report has been issued on the fatal Diesel engine air compressor accident at the Smithfield Markets Supply Co.'s power station (p. 132).

Improvements are described which have been effected in the method of suspension of the filament in the Mazda lamp (p. 133).

A voltmeter for measuring crest values of voltage waves has been described before the American Institute of Electrical Engineers by Mr. L. W. Chubb. It is a permanent magnet instrument working in combination with hot cathode valves and a condenser, and is intended to replace the spark gap for high crest-voltage measurements (p. 133).

Our "Questions and Answers" Page this week deals with the regulation of rotaries by adjustment of alternator exciter voltage (p. 134).

A Paper on "Iron Losses in Direct-current Machines" was read on March 7th before the American I.E.E. by Mr. B. G. Lamme. The causes of variation in iron losses are discussed, and empirical formulæ given for calculating some of them (p. 134).

Among the subjects of specification published at the Patent Office last Thursday were meters, repairing incandescent lamps, rotary converters, lamp locks, and X-ray apparatus. Application has been made for the suspension of several enemy-owned patents for magnetic separators (p. 135).

A new automatic control gear for electric capstans and winches, which includes a fool-proof and weather-proof pedal switch, and contactor panels for the main current, is described in a list issued by the British Thomson-Houston Co., Ltd., Rugby (p. 136).

Negotiations for the supply of tramway rails have been carried on between the Tramways & Light Railways Association and the rail-makers (p. 136).

The Wigan Corporation has called in Mr. H. Dickinson, Chief Electrical Engineer at Liverpool, to advise upon the electrical undertaking.—There was a deficit of £6,410 upon the working of the Southwark electricity undertaking last year (p. 138).

Mains are required at Bexley, and new plant at Watford, West Hartlepool, and Accrington (p. 138).

The excess profits tax was severely criticised at the annual meeting of the British Westinghouse Co.—The Brush Electrical Engineering Co. had a good year in 1915, the carry forward being £2,300 in excess of 1914 (p. 138).

Arrangements for the Week.—(To-day) *Thursday, April 13th.*—Institution of Electrical Engineers. Discussion on "The Present Position of Electricity Supply in the United Kingdom and the steps to be taken to Improve and Strengthen it after the War." 8 p.m.

Friday, April 14th.—Physical Society, at Imperial College of Science, South Kensington, S.W. (1) "The Variation of Resistance with Voltage at a Rectifying Contact of Two Solid Conductors, with Applications to the Electric Wave Detector," by D. Owen. (2) "The Electrical Capacity of a Gold Leaf Electroscope," by T. Barratt. 5 p.m.

Saturday, April 15th.—Chief Technical Assistants' Association, Tavistock Hotel, Covent Garden. Conclusion of discussion on "Advantages and Disadvantages of Various Systems of Laying Mains." 3 p.m.

ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEERS CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D.

Drills, 6.25 to 7.25 : 7.25 to 8.25 p.m.

(To-day) *Thurs., Apr. 13th:* Shooting for Sections III. & IV.

Fri., Apr. 14th: Sections III. & IV., technical; Sections I. & II., squad. and platoon. Signalling class and recruits.

Sat., Apr. 15th: Adjutant's instruction class at 2.30 p.m.

Mon., Apr. 17th: Sections I. & II., technical; Sections III. & IV., squad and platoon; signalling class.

Tues., Apr. 18th: 6 to 7 p.m., school of arms; 7.15 to 8.15 p.m., recruit drill.

Fri., Sat., Sun., Mon.: Easter training.

Promotions and Appointments.

Section Corporal Carman, to Section Commander of No. II. Section; Section Corporal Sayers, to be transferred from No. I. to No. IV. Section; Temporary Corporal Smith, to be Section Corporal of No. I. Section; W. G. Bourke, to be Section Corporal of No. II. Section; J. W. Fyfe, to be Section Corporal of No. III. Section.

Iron and Steel Institute.—The annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, S.W., on Thursday and Friday, May 4th and 5th. In view of the recent discussions as to the expulsion of enemy members from the Institution of Electrical Engineers, some interest attaches to the confirmation of the alteration in the bye-laws of the Iron and Steel Institute, which was sanctioned last year. This provides that all subjects of an enemy country shall forthwith cease to be members of the Institute, but shall be eligible for re-election after the war. The autumn meeting of the Institute will be held on September 21st and 22nd.

Enemy Firms Wound Up.—In a list of enemy firms to be wound up under the Trading with the Enemy Act, published yesterday, appears the name of the M.A.N. Co. (Maschinenfabrik Augsburg-Nurnberg A.G., gas and Diesel engine makers, Caxton House, Westminster, S.W.

SUGGESTED NATIONAL RESEARCH LABORATORY

THERE has been so much criticism, mostly of a destructive nature, of our methods of industrial research and education, particularly during the past 18 months, that it is a little relief to refer to a contribution to the subject of a constructive nature. Mr. A. P. M. Fleming, of the British Westinghouse Co., last week delivered a lecture at the Manchester Municipal School of Technology, under the auspices of the Manchester Engineers' Club, in which, having quite recently completed a tour of the United States, where he made a special study of the whole matter, he was able to bring some new light on a well-worn theme and to make a few practical suggestions. The idea of a national research laboratory has already been taken up in Australia, where a Bill has been prepared with that object in view, and is only awaiting the return to that country of the Premier, Mr. Hughes, for presentation to the Commonwealth Government. The importance of the matter is that it is too often overlooked that, when normal conditions return, probably as severe, if not more severe, competition will have to be met from the other side of the Atlantic as from the Continent, and the manner in which the United States is preparing itself is highly significant. We gave a *résumé* of Mr. Fleming's lecture below :—

Industrial research in the United States is mainly accomplished by individual firms. During the past ten years there have been very considerable sums spent by the leading manufacturing corporations to provide facilities for scientific investigation, annual expenditures for this purpose of £25,000, £50,000, and even £100,000 being not uncommon. In connection with such work, a very broad-minded policy is shown by the publication of the scientific investigations carried out. It is also noteworthy that these research laboratories serve as very effective advertising means by inspiring confidence in the minds of purchasers as a result of such visible evidence of scientific working.

There appears to be no doubt that these laboratories have proved financally successful, not only in that they afford the greatest possible assistance to the works with which they are connected in solving manufacturing troubles, developing new materials, methods, tools, and making discoveries which result in new industrial developments, but also in the direct manufacture and sale in many cases of valuable products straight from the laboratory.

A great deal of the research work of the universities is devoted to purely scientific investigations, but, apart from this, many investigations directed to the solution of particular manufacturing problems are carried out for private firms, and in a number of cases experiment stations have been arranged, the staff of which devote all their time, or at least most of it, to research investigations. The most striking feature of the research work of the universities is the use of a staff of highly trained scientific men who can devote their whole efforts to scientific investigation without the handicap of a great deal of teaching work, as well as of financial anxiety. The researches of the experiment stations are freely published, and in connection with the Illinois State University over eighty important bulletins have already been issued, some of them comprising the most authoritative work on the subjects with which they deal.

Of the national institutions, the most important is that of the Bureau of Standards, which at present does a great deal of investigational work for the Government departments, and is prepared to carry out researches where it can be shown that these are likely to benefit an appreciable section of the public, in which case it is done at the public expense.

The Department of Agriculture is of some interest in that it carries on a scheme of investigational work on national lines. Connected with it are some hundreds of experiment stations in different parts of the States, which deal with experimental work relating to the growth of crops, including fertilisers, pests, etc., cattle-breeding, including the treatment of various diseases. Bulletins are issued to the agricultural communities, both in popular and scientific form, and the organisation provides for lectures dealing with special features of interest to different sections of the agricultural community.

The work done in the United States is of considerable value to us in this country in enabling us to shape our own schemes with reference to research, and although this country is considerably behind in the development of such schemes, considerable advantage accrues in being able to make use of the experience the States have already gained. The distinguishing feature of work done in America is that it is mainly in the hands of private companies, and is carried out in order that one company may more effectively compete with another. The development of the internal resources of the country has occupied most attention, and little work has been done with a view to encouraging export trade. In this country our export trade is of the first importance, and it is here that the country feels the pinch of German competition. The opportunity, therefore, arises to take the greatest possible advantage of laxity in the past, and at the same time to take steps to conserve our overseas trade.

This can only effectively be done by co-operating and pooling our scientific resources, which have hitherto lacked organisation. Doubtless, each manufacturer will in future provide himself with a small laboratory where manufacturing difficulties peculiar to his own works can be solved, but the big advance in the future can only come by concentrating advanced research in a large central institution. The materials, tools, and processes which are common to any industry would be considered in such an institution and efforts devoted to improving them for the common benefit of the industry. Processes which are the monopoly of any individual firm would have to be left out of such a scheme. Difference of factory organisation and management and methods of distribution would still enable manufacturers to compete among each other, but the whole industry would be lifted to a higher plane through discoveries arising from work done at a research institution, which would enable foreign competition to be met most successfully.

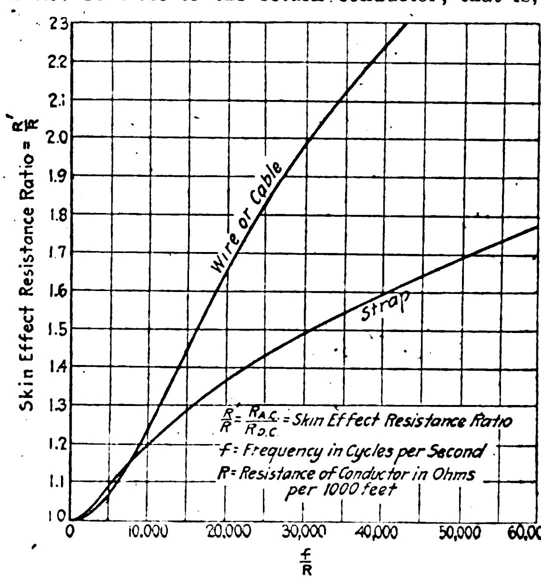
Such an institution would comprise a laboratory for each of the great industries—engineering, shipbuilding, soap-making, dyeing, rubber, paper, metal and textile manufacture, mining, etc.—housed in a large central building. Much of the work done would be along lines of pure science investigation so as to ensure priority of new applications in industry. Patents would be taken out on behalf of the Government, and manufacturers in this country or the colonies licensed to manufacture at a nominal charge.

In view of the fact that industrial research can be made to pay for itself, it would be an excellent investment if manufacturers in this country would devote the necessary percentage of the gross profits arising from industrial processes required to collect and maintain a research laboratory planned on a comprehensive scale. A critical survey of the work already accomplished in the States affords evidence in favour of the success of such a national attempt at industrial research, and ultimately such a scheme might be extended to embrace not only the interests of this country, but also to link up the efforts made in our overseas dominions, such as those of the recently established Bureau of Science and Industry for the Commonwealth of Australia.

CALCULATION OF SKIN EFFECT

AN easy method of obtaining the skin effect—that is, the ratio of the alternating-current resistance to the continuous-current resistance—for wires and strap conductors is described by Mr. H. B. Dwight in the *Electrical World*. Two curves, which we have reproduced, are given, relating the skin effect and the ratio of frequency to resistance for wire or cable and for strap conductors.

The curve for skin effect in strap applies to strap of copper, aluminium, or other non-magnetic conductor. The strap should not be close to the return conductor; that is, there



should be an air space between the strap and the return conductor somewhat greater than the width of the strap. The thickness of the strap should not be more than about one-tenth the width, otherwise the value of skin effect will lie intermediate between the curves for strap and wire. The curve applies to a single strap and not to the case where two or more straps are close together and connected in parallel as in ventilated bus-bars. The curve is applicable for any temperature, since the value of the resistance R is to be taken for the temperature required.

THE TESTING OF TRANSFORMER OIL

EARLY in 1913 the Research Committee of the Institution of Electrical Engineers appointed a Sub-Committee to consider the properties and methods of testing switch and transformer oils. Letters were sent to a number of manufacturers and users of oils, and to universities, and the replies received were reviewed in an interim report by Mr. W. Pollard Digby in January, 1915. The Sub-Committee have considered the suggestions received with regard to the proposed tests, which in the first place are being limited to transformer oils. An abbreviated account of the tests, most of which have been in practical use for some time, is now published in the Institution *Journal*.

In order to judge the suitability of an oil for use as a cooling and insulating medium, it is necessary to know its characteristics in the following respects:—(1) Tendency to sludge, (2) loss by evaporation, (3) flash point, (4) viscosity at different temperatures, (5) chemical reactions, (6) density and coefficient of expansion, (7) cold test (solidification), (8) moisture absorption, (9) dielectric strength, (10) specific resistance, (11) thermal transference, (12) specific heat.

The detailed methods of investigation recommended for each characteristic are briefly reviewed as follows:—

Sludging.—The object of this test is to obtain an idea of the tendency of the different oils to form solid deposits when they are subjected to the action of heat and air. This action is considerably influenced by the presence of certain metals. The method recommended is a modification of that used by Dr. Michie. The oil contained in a flask is subjected to the action of heat and oxygen for a given time, a piece of the metal in question of given surface area being present in the oil during the test. It would be of interest to obtain comparative figures for copper, iron, lead, tin, zinc, and aluminium, and, in view of the importance of copper in electrical work, data should also be obtained for tinned copper, silver-plated copper, and copper covered by insulating material such as cotton.

Besides the formation of solid deposits in the oils after these have been subjected to the conditions of the test, note should be made of any corrosive effects on the metals, the formation of water and acids, and the extent to which the oils have darkened in colour. The depth of colour of the oil can be accurately measured in degrees on a permanent colour scale by means of Lovibond's tintometer No. 7 set for standardising merchantable petroleums.

Loss by Evaporation.—Two different methods of carrying out this test are described. A definite volume of oil is heated in a beaker at 100° C. for eight hours. In one method the body of the beaker is immersed in the heating bath, its open mouth being exposed to the air of the laboratory but shielded from draughts. In the second method the beaker is carried in a revolving tray in a hot-air oven. The result is expressed in terms of loss of volume and ratio of surface to volume of oil, the height of beaker wall above oil surface at the commencement of the test being stated.

"Closed" Flash Point.—The temperature at which vapours accumulating above the oil in a closed vessel become inflammable is determined by means of either the Pensky-Martens or Gray's instrument. The oil is rapidly heated to about 25 degrees C. below its suspected flash point, the heating being continued beyond this at the rate of 2½ to 3 degrees per minute. At each additional degree of temperature the cover is opened and a flame inserted. The lowest temperature at which flash occurs is thus determined.

Viscosity.—The standard method in Great Britain for this determination is that of Redwood, which notes the time in seconds required for a definite volume of oil to run through an aperture of fixed dimensions. Measurements are made at 15·5° C., 50° C., and 80° C.

Chemical Reactions.—The oil is tested for acidity and alkalinity. An iodine test is also recommended, as it is believed that this test gives a good general indication of the tendency to sludge.

Density and Coefficient of Expansion.—The density is determined at the three temperatures 15·5° C., 50° C., and 80° C., by means of specific gravity bottles or pyknometers, preferably of the Sprengel tube type. From this data the coefficient of expansion is obtained.

Cold Test.—This test determines the temperature at which the oil commences to congeal. A knowledge of this characteristic is of importance in connection with oil switches used in exposed situations and cold climates.

Moisture Absorption.—This test is made to determine the tendency of an oil to absorb moisture from the atmosphere, and is made by taking dielectric (breakdown) tests upon the originally dry oil after successive intervals of exposure.

Dielectric Strength and Specific Resistance.—These are familiar laboratory tests.

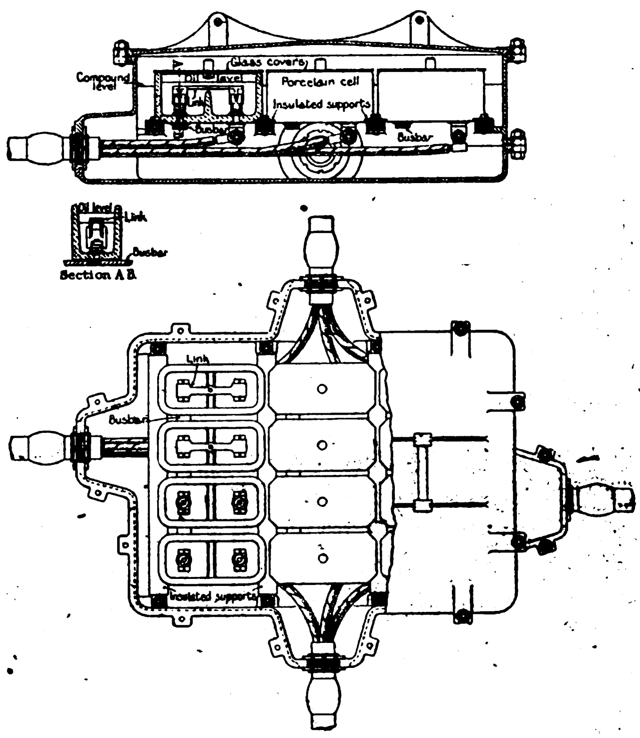
Thermal Transference.—A certain amount of information is available regarding the relative cooling effects in a transformer with oils of different viscosities, but it is felt that more exact information would be of value and a method of investigation recommended by the National Physical Laboratory is described in detail.

Specific Heat.—The method of performing this test is left to the judgment of individual experimenters. Data should be obtained at 15·5° C., 50° C., and 80° C. Reference is given to published data upon this subject. It is suggested that specific heat tests at 15·5° C. might with advantage be made upon the oils both in their original condition and after drying, but for the test at higher temperatures, dried oil should be employed.

E.H.T. SERVICE BRANCHES

A PAPER by Mr. D. M. Macleod, read before the Scottish Local Section of the Institution of Electrical Engineers on Tuesday at Glasgow, dealt with a method of making service connections of moderate load capacity to E.H.T. ring main systems, where the distance of the new consumer from the nearest point on the existing main did not warrant the expense of looping in a cable of the full size of the main nor the installation of a special switch-house on the route of the main. The case has been met by the author by the use of a special form of E.H.T. link-box, many examples of which, notwithstanding the warnings of several of the manufacturers originally asked to tender, have been in successful use for the last eight years.

The design described in the paper was supplied by Siemens Bros. & Co., and the general arrangement is shown in the figure. It is important to note that each main and service cable is brought into the box in such a manner as to leave no doubt as to its identity. The box is of cast-iron in three portions to facilitate jointing, and is fitted with a porcelain cell for each cable core. Through the bottom of the cell pass two



studs, one of which is in metallic contact with a bus-bar and the other is directly connected with one of the cores of the cable. To these studs are attached two main contacts, connected together by a removable link immersed in oil. Each cell is provided with a glass cover, and in the centre of each link is a screwed hole into which the operating rod is screwed when the removal or insertion of a link is either necessary or desirable. These cells are assembled in groups corresponding to the number of phases, and they are imbedded in the box compound with which the greater portion of the cast-iron box is filled. The bottom joint passes through the main cable glands, and the faces are machined and fitted throughout. This arrangement provides the maximum of accessibility, in so far as that it allows of all the cable cores being set into position and jointed up before the box is finally assembled, and when this is done nothing remains but carefully to "wipe" the lead of the cable to the brass glands of the box.

The complete jointing of such a box would take too long to be done on site, so short lengths of cable of the requisite size are jointed up to it first and the box is transported *en bloc* to the site, where two or more cable jointers make

the necessary joints in the minimum of time. Moisture inside the box is eliminated by calcium chloride in an exterior vessel directly connected with the box by a tube.

It has been found quite feasible in practice to take branch services off sections of cable controlled by balanced protective gear, as the disturbance in static balance in the current transformer secondary circuit is not sufficient materially to affect the efficiency of the protective system. It has, however, been found advisable to instal a no-volt release at the supply or consumer's end of such service branches, as otherwise the static balance is liable to be disturbed in the event of any sudden fluctuation of voltage caused, for example, by a fault on the external circuit. An advantage of such a system of single branch services is simplicity, which in itself tends to reliability.

In connection with the present crisis, continues the author, sundry war service supplies have been given from these link-boxes, this course being dictated by the extreme urgency of the demand and the difficulty in obtaining deliveries of switch-gear owing to manufacturers' work coming under Government control for the manufacture of munitions. These services have been maintained under the most onerous conditions without the slightest interruption, and have proved themselves to be entirely satisfactory from every point of view.

CHURCH LIGHTING

THE effective lighting of a church at a reasonable cost is by no means an easy proposition for the illuminating engineer. A lofty building, covering a large area, and having few surfaces to assist reflection, and the presence of pillars, archways, galleries, and screens, are factors that militate against economy and uniformity in the distribution of light. Fittings should harmonise with the architectural features of buildings, which should themselves be brought into prominence rather than obliterated by the lighting effect, as frequently is the case. Where the roof is at a great height and has a dark surface that absorbs rather than reflects light, direct lighting must be adopted, but it does not follow that the lamps or their fittings should be visible. Satisfactory lighting can be secured with concealed light sources, as is shown by a scheme that has been adopted at St. Dunstan's Church, East Acton, of which we give illustrations. This installation is of interest, both because the system employed is novel and effective and on account of its low cost.

The contractors for the work, Messrs. Duncan Watson & Co. (62 Berners Street, Oxford Street), in consultation with the Illuminating Engineering Department of the British Thomson-Houston Co., Ltd., hit upon the idea of

FIG. 1.—LIGHTING OF ST. DUNSTAN'S CHURCH, EAST ACTON, BY MEANS OF CONCEALED FITTINGS.

dispensing entirely with fittings as usually understood, and of lighting the church by trough reflectors concealed between the mouldings of the arches at the points where the latter spring from the pillar capitals.

Three Mirolux extensive type trough reflectors, each equipped with two 60-watt standard Mazda lamps, are provided on the east side of the pillars on both sides of the nave. Persons passing up the church, therefore, can see neither fittings nor the light sources, the illumination being thrown forward and distributed with remarkable evenness throughout the building. The lamps and fittings can be seen, of course, when passing down the building from the east end. The value of the illumination on the working plane—*e.g.*, on the top of the pews—averages 2·5 and 3 foot-candles, which is well above the figure usually allowed for church lighting, and permits of the congregation following the service in comfort, even with books having the smallest type.

For the lighting of the chancel a pair of similar reflectors, each with two 60-watt lamps, is placed on the east side just

FIG. 2.—ARTIFICIAL LIGHT PHOTOGRAPH OF THE ALTAR.

above the lower capitals of the pillars supporting the main arch, while light is thrown upon the altar by single trough reflectors placed within the reveals of the two side-windows.

A telescopic standard, carrying a conical reflector concealing a standard lamp, is placed behind the vicar's stall, and this illuminates also the book on the lectern alongside. The music on the organ is lighted by a tubular lamp with adjustable reflector. The circuits are so controlled that almost any variation in the light can be secured at will. Thus, during the sermon, alternate fittings or individual reflectors in the groups in three, can be switched out. Over the entrance to the lady chapel is a large cross, which has been outlined with 12 Mazda lamps with specially small bulbs.

The wiring is enclosed n heavy gauge screwed barrel throughout. Although it has been run on the surface, especial care was taken to make the runs as inconspicuous as possible, and at a casual glance no evidence of the conduit is visible. Current is supplied from the d.c. mains of the Metropolitan Electric Supply Co. at 230 volts. The accompanying illustrations have been reproduced from untouched photographs taken by the unaided light of the fittings installed.

DIESEL ENGINE USERS' ASSOCIATION

Air Compressor Accident at Smithfield Market

AT the March meeting of the Diesel Engine Users' Association the subject of tar oils as fuel was further discussed, and the President, Mr. Geoffrey Porter, gave some particulars concerning the unfavourable results which had been obtained in mixing tar or tar oils with ordinary crude oil for use in Diesel engines. In a discussion which followed on the use of paraffin oil as fuel, the opinion was expressed that this oil could be quite suitably used when its price was favourable. It was necessary to run at a lower blast pressure when using paraffin.

The Honorary Secretary then read a report which had been made to Lloyd's Underwriters by Mr. P. H. Smith on the recent accident at the Smithfield Markets Electric Supply Co.'s power station, when one of the drivers was killed.

The compressor attached to the engine is of Messrs. Reavell & Co.'s standard quadruplex type, comprising four cylinders, namely, two low-pressure cylinders, one intermediate and one high pressure. The air is drawn into the low-pressure cylinders through slots in the piston pin, and is then compressed, passing into the L.P. receiver or purge pot, through copper pipes immersed in the water jacket of the compressor. This purge pot contains a drain and regulating valve, and a relief valve set at about 100 lb. per square inch. The air from the L.P. purge pot is drawn into the I.P. cylinder past a valve through another cooling coil. Then it is compressed and delivered past another valve into the I.P. purge pot, which is almost

identical with the L.P. pot, except that its relief valve is set to blow freely at 300 to 400 lb. pressure. From the I.P. pot it passes into the H.P. stage, from which it is delivered to the small bottle, being cooled immediately after passing the H.P. delivery valve.

What happened was that the I.P. purge pot burst. This was of good average quality iron of even thickness. Mr. Smith submitted the opinion that the cause was spontaneous ignition of oil vapour in the I.P. purge pot, and in accordance with this he made the following recommendations: (1) Fit pressure gauges on both L.P. and I.P. purge pots. (2) Plug the holes leading behind the I.P. rings. (3) Fit on a large relief valve to the I.P. and L.P. pots, and test these periodically for lifting pressure.

METAL FILAMENT IMPROVEMENTS

THE electric incandescent lamp is such a simple affair that one hardly looks upon this as offering a field for progress, yet the glow lamp of to-day is a very different article from that of thirty years ago. Even since the introduction of the tungsten filament improvements have continued to be effected, which, though small in themselves, have each contributed to the largely increased efficiency, life, and strength of the present-day lamp. Our illustrations show one important improvement effected by the British Thomson-Houston Co. and applied to the Mazda lamp. When filaments of squirted tungsten were used, involving a number of short hairpin-shaped pieces, the ends had to be cemented or welded to stiff supports radiating from the central glass stem (Fig. 1). This construction was weak mechanically, hence the frequent fracture of the filament at or near the joint, which was not elastic. With the introduction of a filament formed from one continuous length of drawn wire, these intermediate joints were no longer needed, the filament

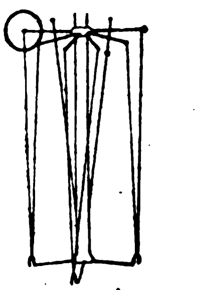


FIG. 1.—PRESSED FILAMENT WITH WELDED SUPPORTS.

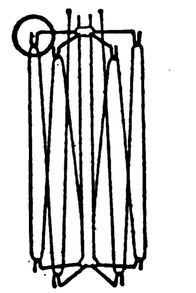


FIG. 2.—DRAWN-WIRE FILAMENT WITH HOOK SUPPORTS.

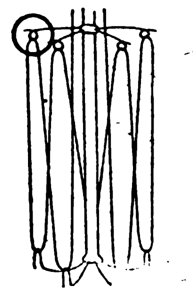


FIG. 3.—MAZDA DRAWN-WIRE FILAMENT WITH CLOSED LOOP TOP SUPPORTS.

loops being supported by a "spider" consisting of hooked wires over which the wire was wound (Fig. 2). This removed the great source of trouble, and by the absence of joints and the freedom at the supports fewer filament breakages occurred, but it was possible for the filament to become dislodged by vibration. Finally, however, the hooked-wire support was superseded by what is known as the "pig-tail" loop (Fig. 3), a feature incorporated in Mazda lamps. The filament loops are passed into the "pig-tails," which, by their form, prevent the filament becoming detached, however violent may be the vibration to which the lamps may be subjected. Moreover, it provides a spring support that allows for expansion and contraction of the filament and for a limited freedom of movement within the coil of the "pig-tail," which greatly reduces the liability of the filament to fracture.

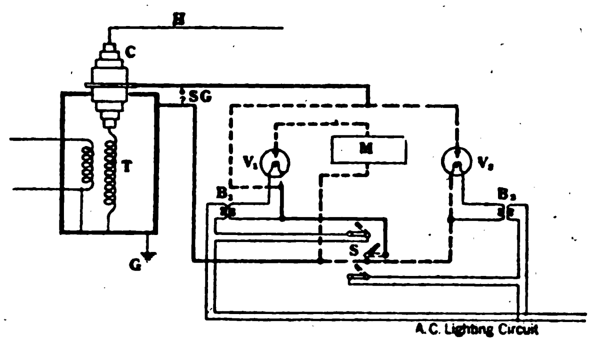
The Manchester Local Section.—At the annual meeting of the Manchester Local Section of the Institution of Electrical Engineers on Tuesday, Mr. A. McKenzie, the deputy chief electrical engineer to the Manchester Corporation, was elected chairman, and Messrs. C. J. Beaver and A. P. M. Fleming vice-chairmen.

Supplementary Examination in Electric-Light Switching.—At the end of this month the results of the competition just closed will be published in this journal. Meanwhile, we are asked by Messrs. A. P. Lundberg & Sons to announce the fact that owing to the success of this competition a supplementary examination will be conducted shortly on the same sets of problems. Particulars will be issued to old and intending new competitors early next month; and those who have a copy of the February examination pamphlet should keep it by them. Those who have not can obtain one on application within the next three weeks.

CREST VOLTAGE MEASUREMENT

THE breakdown of dielectrics under test is dependent more upon the crest or maximum value of the applied voltage than upon the r.m.s. value, and a demand has naturally arisen for methods of measuring crest values. The spark-gap, of course, is one method, but often an inconvenient one, and schemes have been evolved for measuring crest value direct by voltmeter. One such meter, which is illustrated below, has recently been described in a Paper before the American Institute of Electrical Engineers by Mr. L. W. Chubb. This is a modification of a form devised by Messrs. Whitehead & Gorton, the change consisting in the substitution of hot cathode tubes for mercury arc rectifiers.

The instrument is mounted on a small panel to be placed near the control apparatus of the testing transformer. It consists of a permanent magnet instrument sensitive to low currents, two small hot cathode valves mounted inside two drawers, a frequency meter, an exciting switch, and, on the back of the panel, two bell-ringing transformers for heating the cathode filaments of the valves. In the diagram of connections below, T is the testing transformer diagrammatically shown in an earthed case; C is a condenser terminal used to bring out the high-tension lead H; V_1 and V_2 are two rectifiers or valves having an anode of tungsten or molybdenum and a cathode of incandescent tungsten working in an atmosphere of mercury vapour, or one of the noble gases at low pressure. B_1 and B_2 are the small transformers referred to, the primaries of which are connected to any suitable A.-C. lighting circuit; M is the indicating instrument connected in the anode lead to the value V_1; S is three single-pole switches operated with a single handle and used to close the cathode heating circuits or short-circuit the



instrument when not in use; $S.G.$ is a safety gap between the leads to the meter to protect the insulation of the apparatus in case of interruption in the supply to the bell-ringing transformers when the switch is in the working position, or in case of an accidental open circuit in the instrument wiring. The frequency meter is not shown in the diagram; it is not an essential part of the measuring apparatus, but may be included to make a proportional correction when the frequency varies appreciably from normal.

The condenser terminal or other condenser connected to the high-tension lead takes a charging current at all times proportional to the differential or rate of change of voltage across its terminals. At both the positive and negative maxima of the voltage waves this current is zero and the time integral or area of the current wave between these zero values is a direct measure of the difference between the maximum and minimum voltages. On account of the asymmetrical conduction of the cathode valves, the arrangement of circuits shown in the diagram is such that the charging current in one direction passes through the instrument M and the valve V_1 as shown by the heavy dotted line. Current in the opposite direction passes through the valve V_2, without passing through the meter, as shown by the heavy broken line. The light lines in the figure represent the primary and secondary exciting circuits for the cathode filaments fed from the lighting circuit. When the meter is not in use the switch is thrown to the right, which short-circuits the apparatus and opens the primary circuits of the exciting transformers.

The torque of a permanent magnet meter is proportional to the average value of the current passing through it, and since for waves of constant length the area is proportional to the average height of the current, it is evident that the meter will give an indication proportional to the time integral of the pulsating current through the valve V_1, and this will in turn be proportional to the crest of the voltage wave.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,490.

Which is the best way to ascertain if series winding on a 150-kw. 220 volts D.C. generator is opposed to shunt? The machine has interpoles, and runs in parallel with another (having no interpoles), so power is available for any test. The voltage on machine to be tested is 230 running light, but with 600 amps. load drops to 210; the rated voltage is 220; this drop occurs when machine is in parallel, and also when taking load alone, so brush position relative to generator running and resistance of equaliser connections need not be considered.—BOOSTER.

(*Replies must be received not later than first post, Thursday, April 20th.*)

ANSWERS TO QUESTION No. 1,488.

Three six-phase 500-k.w. rotary converters are run direct from a turbo-alternator through the necessary switchboard connections. The alternator has an exciter on the end of its shaft, and it is proposed to lower the D.C. voltage on rotaries by lowering the voltage on exciter, the alternator and rotaries being fully loaded. Is it possible to do this, and is there any danger in doing so?—ROTARY.

The first award (10s.) is made to "W. H." for the following reply:—

It is quite possible to run rotary converters on a lower voltage than the machines were originally designed for, the result of lowering the A.C. voltage will be, of course, a corresponding percentage decrease in the D.C. output voltage. The method proposed, viz., to lower the excitation current of the alternator, is quite feasible, even when the machines are on load. Care will have to be taken in decreasing the exciter voltage, as the alternator and exciter will become rather unstable on the weak field. The power factor of the A.C. side will be considerably affected, as the rotaries having their original excitation will be over-excited on the lower voltage, thus producing a leading circulating current. To get over this trouble it will be necessary to reduce the rotary excitation to again obtain unity power factor.

There should be no danger in effecting this operation if performed with care, although there may be trouble on the supply system caused by lowering the voltage. This, of course, depends on the nature of the load.

This actual procedure has been adopted at a colliery power station in Scotland to produce a lower voltage than was ultimately required. It operated successfully, in conjunction with a voltage regulator, for some months.

The second award (5s.) is made to "Alpha" for the following:—

The method of control proposed by "Rotary" is quite possible, and is, in fact, the simplest method where it can be applied—that is, where the alternator is used only to supply power to the rotary converters. It will, of course, be understood that it is not possible to vary the D.C. voltage by this means and at the same time maintain a constant-voltage A.C. supply from the alternator for other purposes. No difficulty whatever should be experienced in ordinary service, the only danger being that, if the exciter field current is reduced too much, the exciter (being presumably shunt wound, self-excited) will become unstable and drop its volts. In this case the alternator voltage would drop to zero, and the converters would, of course, fall out of step, sparking badly. If a considerable reduction of voltage is required, it would be well to determine the point at which this trouble might occur by running the alternator at full voltage with the rotaries disconnected, and then lowering the volts by the exciter field rheostat. If this rheostat has sufficient resistance, a point will be reached where the volts will rapidly fall to zero. This point can be marked either on the exciter rheostat or on the exciter voltmeter, and any regulation required below this point obtained in practice on the alternator field rheostat. When running with considerably reduced voltage it will be necessary also to reduce the field currents of the rotary converters, otherwise they will draw leading currents tending to keep up the voltage of the alternator. The converters should preferably have such a field as will give approximately unity power factor (say, between 95 per cent. lagging and 95 per cent. leading) at full load. If they are not provided with power-factor indicators, the correct position of the rotary converter field rheostat for any particular voltage can be found with sufficient accuracy by running the converter light at the required voltage and setting the converter field rheostat at the point which gives the minimum A.C. current input to the machine. This will be the position for unity power factor at no load, and will be correct for full load if the converter is compound wound. If it is shunt wound it will be found that about 15 to 20 per cent. more field current will give (roughly) unity power factor at full load. By attending to the above points it will be found that the machines are quite stable and satisfactory down to half-normal voltage or less, if the rheostats available have sufficient resistance to give this reduction, and presumably the range required in service by "Rotary" is considerably smaller than this.

IRON LOSSES IN D.C. MACHINES

An interesting summary of the problem of core losses, and an investigation into the extent to which the problem is capable of solution, are provided in a Paper read on March 7th before the American Institute of Electrical Engineers by Mr. B. G. Lamme. The term "iron loss," as used in connection with rotating machinery, is shown to cover a large number of losses, some of which do not actually occur in the iron itself. The term "core loss" is therefore to be preferred. Any calculation of the core loss is necessarily only approximate, partly due to variable conditions of manufacture and material, and it is impracticable to expect any refinement in calculation closer than 20 per cent. The core losses of two machines, built at different times from the same drawings and the same tested grade of materials, may vary to this extent.

It is well known to designers, the author stated, that figures for iron loss applicable to transformers require to be increased, in some cases by 100 per cent. or more, when applied to rotating machinery. This is due to additional causes of loss which do not occur to any appreciable extent in transformers, for example, hammering or bending of the laminations after annealing; the operation of punching, which produces burrs and therefore uneven stresses in the assembled core; filing slots and cores; too tight clamping of the core, which has been known to increase the temperature of the end sections of the iron by 30 to 50 per cent.; and pole face losses.

The author considers the four principal sources of loss, namely, armature ring loss, armature tooth loss, eddy currents in buried conductors, and pole face losses. It is shown that eddy losses in conductors are due to the peculiarities of flux distribution in the armature teeth. As these pass under the edges of the poles there is a very rapid rise and fall of flux across the armature slots, due to the difference of magnetic potential in two teeth which are passing from a field of great to one of small intensity. The following empirical formula, for slots with two conductors deep, is given for calculating this loss:

$$\text{Watts loss} = \frac{135\ VRp(4000 + a)a}{10^{8}}$$

where V is the total volume of copper, in cubic inches, in one slot; R is the revolutions per second; p the number of poles; and a the maximum ampere-turns for one tooth. This

formula is shown to agree fairly well with a number of observed results.

With regard to pole face losses, the author observes the difficulties in determining a workable formula, but gives the following for a rough approximation :—

$$\text{Watts loss} = \frac{75bE^2}{CW^2gL}\sqrt{\frac{S}{Rg}}$$

in which b is width of slot, E is generator voltage, C is field form constant, W is armature wires in series, g is single air-gap (iron to iron), L is width of pole face, and S is total slot space (width of slot × no. of slots).

The author then discusses the core losses at full load, and shows that while the no-load losses are difficult to predetermine, the full load losses are still more difficult to calculate. Here the effects of flux distortion by the armature magnetomotive force tend to exaggerate the pole face losses and those in the armature copper, which are the two relatively large losses most difficult to calculate at no-load. The eddy loss in the copper can be calculated from the formula already given for no-load conditions, by using the ampere-turns in the teeth based on load conditions, and halving the result, as the peak flux density occurs at only one edge of the pole. Calculations on this basis for some old machines show the startling fact that the eddy current copper loss at heavy load is several times as great as that at no-load. The increase in pole face losses on full load are not so serious, and it is suggested that it might be advantageous in some cases to decrease the field distortion by pole face saturation, even at the expense of increasing the no-load pole face losses.

Resistance Thermometer Ammeter.—A substitute for the hot-wire ammeter was described by S. Leroy Brown at a recent meeting of the American Physical Society. The essential feature of the instrument is a small coil of fine wire which surrounds the element of a sensitive resistance thermometer. Any method of resistance measurement may be employed to register the change in resistance of this element due to the heating effect of a current in the coil. An instrument can easily be built on this plan which is sensitive to a few milliamperes. For larger currents the coil would be made of larger and lower resistance wire, and for very small currents a heating coil of very fine high resistance wire can be used. The higher range of a particular coil is about ten times the lowest measurable current; that is, the range may be from 10 to 100 milliamperes, or from 100 to 1,000 milliamperes, etc. This method of measuring electric currents has been used for the following purposes :—1. As a comparator for the calibration of alternating current instruments by comparison with direct current standards. 2. For measuring high frequency currents. 3. Experimental determination of the effect of coupling, tuning, etc., in the generation of electric waves.

Modern Development of Water Power.—One of the most complete Papers that we know of on the modern development of water power was read a short time ago by Mr. Alphonse Steiger before the Society of Engineers. Mr. Steiger is one of the best recognised authorities on hydraulics in this country, and for many years represented Messrs. Escher, Wyss & Co., of Zurich, and at the present moment is acting for Messrs. Theodor Bell & Co., of Kriens, Switzerland. Copies of the complete Paper and discussion are now available at the price of 2s., including postage, and are obtainable from Mr. Steiger at 32 Victoria Street, S.W.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published April 6th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

3,856/15. **Meters.** LANDIS & GYR A.G. Induction type integrating 3-phase watt-hour meters comprising a main current coil co-acting with a shunt coil the field of which is 30° in advance of the field of the main current coil when the load is non-inductive, in combination with a second main current coil working in conjunction with a shunt coil the field of which lags 30° behind that of the second current coil. (Six figures.)

3,949/15. **Incandescent Lamps.** C. A. HARRISON. A method of repairing metal filament lamps, of the type having a single set of supporting arms, by opening the pip end, cutting away the glass stem, and attaching to the remaining portion auxiliary arms upon which a new filament is placed. (Five figures.)

4,401/15. **Rotary Converters.** M. WALKER. A rotary converter the virtual position of the poles of which can be moved in respect to the brush position by changing the polarity of portions of the poles and by a commutating pole excited from a double brush. (One figure.)

5,628/15. **Lamp Locks.** W. G. RUDD. A lamp lock contained within the dome of the holder actuated by a removable key, and arranged to lock the spring contact plungers in their forward position to prevent removal of the lamp. (Five figures.)

9,428/15. **X-Ray Apparatus.** B.T.-H. Co. (*G.E. Co., U.S.A.*). X-Ray tubes in which the surface subjected to the discharge is continually renewed by rotating the tube as a whole and magnetically deflecting the cathode beam out of the axis of rotation, whilst keeping the focal spot fixed in space. (Two figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: HERBERT TERRY & SONS, LTD., and TERRY [Cables, &c.] 4,138/15; BOWDEN and THOMPSON [Cables]

Dynamos, Motors, and Transformers: WADE (*Leeson*) [Coil-winding machines] 4,230/15; B.T.-H. Co., (*G.E. Co., U.S.A.*) [Dynamo regulation] 6,407/15.

Ignition: B.T.-H. Co. and YOUNG [Magnetos] 4,664/15; KENNEDY-MCGREGOR [Sparking-plugs] 6,708/15; THOMAS TRANSMISSION, LTD., and THOMAS [Timing ignition] 7,316/15.

Switchgear, Fuses, and Fittings: VAN SWAAY and KEUS [Maximum cut-outs] 2,697/15; DEHN (*Schweitzer & Conrad*) [Fuses] 4,483/15; B.T.-H. Co. and WEDMORE [Protective gear] 4,595 and 4,738/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Controllers] 7,211/15.

Telephony and Telegraphy: HULTMAN [Automatic telephone exchanges] 4,285/15; JAMES (*Annand*) [Telegraph receiving apparatus] 10,485/15.

Miscellaneous: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Electric ship propulsion] 2,841/15; STERLING TELEPHONE & ELECTRIC Co., BELL and BARCLAY [Mine signalling systems] 4,675/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Amplification of potential variation] 5,373/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Electric welding and brazing] 8,543/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Ignition: C. T. MASON [Ignition dynamos] 2,701/16 (*100,173*).

Telephony and Telegraphy: NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSHE THERMO-TELEPHOON MAATSCHAPPIJ [Thermic telephones] 5,845, 5,846, and 5,847/15; SOC. FRANÇAISE RADIO-ELECTRIQUE [High-frequency alternator] 3,745/16 (*100,184*).

Miscellaneous: W. L. WALKER [Battery cells] 3,161/16 (*100,176*).

Application for Suspension

14,082/08 ULLRICH, 17,459/09 LAKE (*F. Krupp A.G. Grusonwerk*), 29,201 and 29,224/11; F. KRUPP A.-G., 29,230/11; ULLRICH, 14,426, 14,427, and 24,355/13 F. KRUPP A.G. **Magnetic Separators.**—Applications for the avoidance or suppression of these enemy-owned patents, all of which relate to magnetic separators, will be heard before the Comptroller to-day.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Incandescent Lamps: W. P. THOMPSON (*Deutsche Gasgluhlicht Ges.*) [Osmium filaments] 27,713/04.

Storage Batteries: S. LAKE [Secondary batteries] 29,147/06.

Switchgear, Fuses, and Fittings: W. H. JAMES [Fuse-boxes] 25,478/04; A., S. A., G. O. H., and E. H. HORSTMANN and W. T. EDGAR [Time switches] 27,849/04; SIEMENS BROS. & Co. [Surge arresters] 28,018/04; B.T.-H. Co., H. C. HASTINGS and W. L. WISE [Controllers] 29,785/09.

AUTOMATIC CONTROL FOR CAPSTANS AND WINCHES

It is generally recognised that efficient and reliable control gear of the automatic and fool-proof type is absolutely necessary for the successful operation of electric capstans and winches,

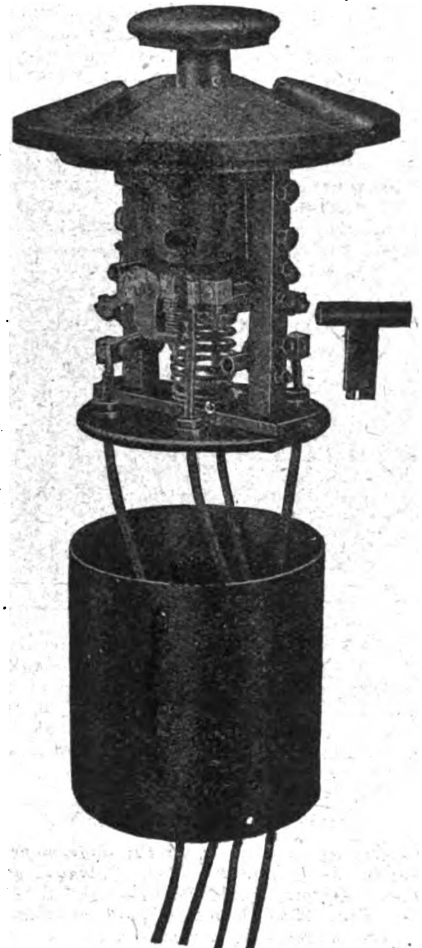


Fig. 1.—Interior of Capstan Pedal Switch.

and that it should be specially designed to withstand the severe conditions under which it will be used. A control gear to fulfil these conditions has been developed by the British Thomson-Houston Co., Ltd. (Rugby), and is described

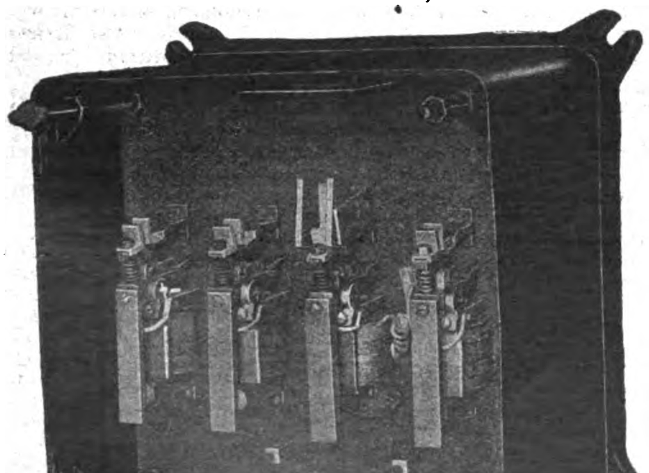


Fig. 2.—B.T.-H. Type S.M.C. Automatic Starting Rheostat.

in their new list No. 5,313. The system is arranged so that complete control can be effected by simply actuating a pedal switch, this necessitating a minimum of attention from the operator, who can be free to handle the slack rope. The control gear includes a pedal switch, illustrated in Fig. 1, which is designed for use on an exposed wharf, and an accelerating unit (Fig. 2), consisting of a series of contactors.

The pedal switch does not carry the main current, but when depressed closes the operating coil circuit of the first or shunt contactor, causing it to close and complete the motor circuit through the starting resistance.

The remaining contactors close successively and cut out

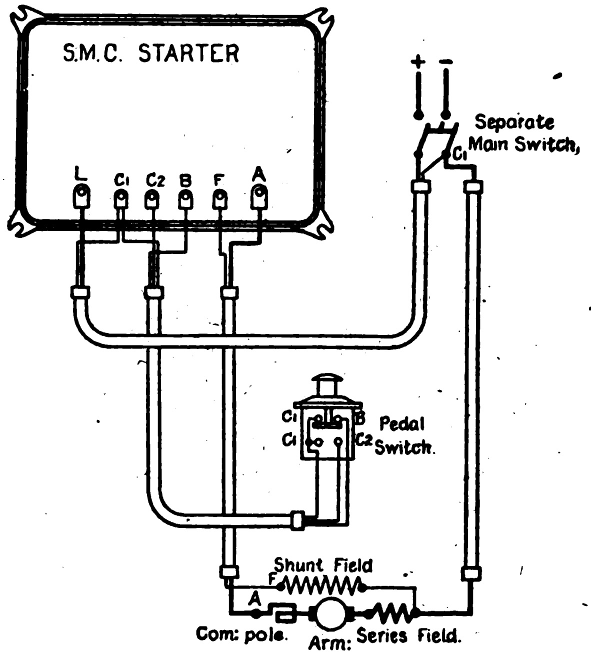


Fig. 3.—Diagram of Connections for B.T.-H. Capstan Control Equipment.

sections of the starting resistance, each section being cut out automatically immediately the acceleration of the motor has caused the main current to decrease to the value at which its contactor is set to operate. A diagram of connections is shown in Fig. 3. The resistance units are made in tubular form, and consist of non-corrodible wire wound on enamelled steel tubes, the wire being only slightly sunk into the enamel and not embedded therein.

ELECTRIC TRACTION NOTES

Some time ago we mentioned that a Special Committee of the Tramways and Light Railway Association had been formed with a view to seeing what could be done to facilitate the supply of tramway rails. The March issue of the *Journal* of the Association states that negotiations are taking place with the rail manufacturers with a view to securing a supply during the next twelve months. For this purpose, members are asked to supply the Secretary with the minimum quantity of rails and fish plates which are absolutely required for keeping their undertakings going. Manufacturers will shortly quote prices, and it will then be necessary to apply to the Minister of Munitions for permission to roll the rails and grant licences for delivery.

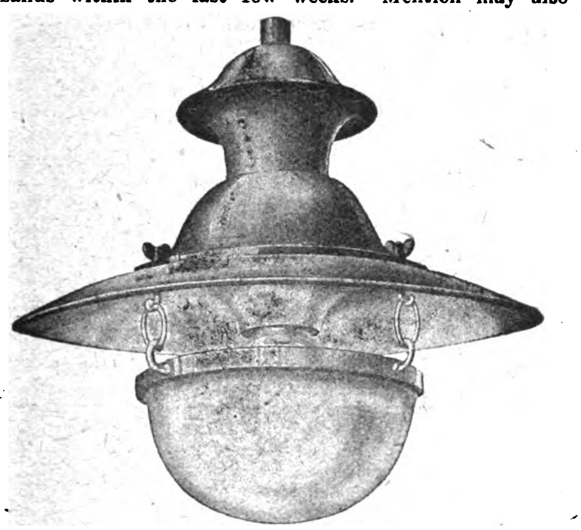
A long sitting of the Edinburgh Tramway Committee took place on Wednesday to discuss the question of converting the cable tramway system to electric traction. Negotiations have been going on with the Cable Tramway Co., which provides the rolling stock (cars and cables), whilst the power stations, rails and permanent way, &c., belong to the Corporation. The Corporation, however, is not under any obligation to take over the rolling stock from the company at the end of the lease in June, 1919. A difference of opinion has arisen between the Corporation and the company as to the price which should be paid for the rolling stock, the Corporation putting the value at £25,000 and the company valuing it at £75,000. For the moment the Committee has confined itself to making arrangements for the proper upkeep of the track between now and the expiration of the company's lease. There is a general disposition to favour the conversion of the lines to electric traction, but it is felt that there is no need for haste in arriving at a decision.

INDUSTRIAL LIGHTING FITTINGS

THE number of industrial lighting fittings which are making their appearance indicates the great interest which is now being shown in this aspect of lighting. Simplex Conduits, Ltd. (Garrison Lane, Birmingham), have just issued a list of lanterns and reflectors suitable for industrial lighting, among which may be mentioned enclosed lanterns for half-watt lamps,

"Simplex" Concentrating Reflector.

of pleasing design, strong and well finished, and indirect and semi-indirect fittngs suitable for offices and other public positions where the glare of very high candle-power lamps is very objectionable. A special point is made of the inexpensive anti-Zeppelin reflectors, of which Simplex Co. have sold many thousands within the last few weeks. Mention may also be



"Simplex" Half-Watt Fitting.

made of the new concentrating reflector specially designed for workshops and office local lighting, as being a useful and inexpensive type, and there are also illustrated reflectors for the larger types of half-watt lamps for positions where it is proposed to replace arc lamps. Our two illustrations are typical of the patterns listed.

CATALOGUES, PAMPHLETS, &c., RECEIVED

EXTENSIBLE LADDERS.—Messrs. H. J. Heathman & Co. (Parson's Green, London, S.W.) send us a very complete catalogue of their extensible ladders and fire-extinguishing apparatus. Special types of ladders have been evolved for such purposes as arc lamp trimming, trolley-wire repairing, etc.

War Tribunals.—At Salford last week a consulting electrical engineer was granted exemption until June 30th, it being stated that he was doing special work in connection with the port of Manchester at Trafford Park. He was, he said, responsible for designing and carrying out the whole of the electrical machinery to equip a warehouse there.—A cinematograph theatre electrician has been granted exemption for a month by the Market Bosworth Tribunal on the casting vote of the Chairman, on the ground that he is engaged on work which provides amusement for wounded soldiers.

ELECTRIC VAN FOR ELECTRIC LAMP TRANSPORT

A SHORT while ago we mentioned that the British Thomson-Houston Co., Ltd., had taken over the Rugby skating rink and adapted it for the purpose of storage accommodation for Mazda lamps. The new store being some distance from the lamp works, a two-ton electric van has been put into service for carrying cases of finished lamps from the works to the new

store. Occasionally the vehicle is employed for the transport of goods between Rugby and the Coventry Meter and Instrument works, this trip involving a run out and home of about thirty miles. We illustrate the lorry, photographed at the entrance to the lamp store. Charging is carried out at the B.T.-H. Rugby works, which also supplies the town of Rugby.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"A Treatise on Electricity." By F. B. Pidduck. 646 pp. 9 in. by 5¾ in., 369 figures. (Cambridge: The University Press.) 14s. net; abroad, 14s. 10d.

"Whittaker's Arithmetic of Electrical Engineering." 212 pp. 7½ in. by 5 in. 18 figures. (London: Whittaker & Co.) Third edition. 2s. net; by post, 2s. 3d.

"An Introductory Course of Continuous-current Engineering." By A. Hay. 360 pp. 8¾ in. by 5½ in. 199 figures. (London: Constable & Co., Ltd.) Second edition. 6s. 6d. net; abroad, 7s. 2d.

"British Destiny: The Principles of Progress." By D. N. Dunlop. 113 pp. 7½ in. by 5 in. (London: The Path Publishing Co.) 3s. 6d. net; abroad, 3s. 9d.

Electricity in Mining.—At a recent meeting of the Yorkshire Branch of the Association of Mining Electrical Engineers Mr. H. Elliott read a paper, reported in the *Iron and Coal Trades Review*, describing the electrical plant at Frickley Colliery. In the course of his paper Mr. Elliott commented on the uses of electricity in mining work generally, saying that it is now possible by the aid of electrical machinery to work seams which, either for financial or technical reasons, have previously been unworkable. A very unfair prejudice had existed against colliery electrification on the ground that electricity in mines is dangerous, but it was impossible to produce any evidence which could justify such prejudice. The lives lost in collieries in proportion to the output have greatly diminished since the introduction of electrical power, and accidents that have been directly caused by electricity have usually been due to one of two causes:—(1) the plant installed has been unsuitable for its work; (2) the plant has been badly installed and maintained. Electricity cannot be trifled with, and unless it is intended to instal a reliable plant to commence with, and to see that it is properly maintained, it should not be installed at all. A modern large colliery is now equipped with machinery which compares very favourably with and is in many cases superior to, other classes of modern engineering, and on this account demands all the skill and care that can be spent upon it by a fully-qualified mining electrical engineer. A proper system of inspection and testing must be organised, and this applies particularly to the testing of the insulation of the motors and cables.

LOCAL NOTES

Stockton-on-Tees: *Bulk Supply.*—The extent to which the power companies on the North-east Coast are bringing home to some of the supply authorities the advantages of bulk supply, as compared with generation in small power stations, is seen in the accounts of the Corporation for last year. The figure for the purchase of electricity is £3,080, against £628 for the previous twelve months, and this in turn is reflected in the estimated cost of coal for the current year, namely, £800, as against £1,996, and the estimated wages of £450, compared with £944.

Southwark: *Electricity Deficit.*—The accounts for the year to March 31st show a deficit of £6,410. This is made up of £5,728 decrease in sales, increase in wages rates and war service allowances account for £528, and the balance is due to the scrapping of old stokers. After some discussion the accounts were passed, the Mayor expressing the opinion that the losses had been quite unavoidable.

Wigan: *Position of Electricity Undertaking.*—Mr. H. Dickinson, City Electrical Engineer of Liverpool, has accepted an offer by the Corporation to act as Consulting Engineer in connection with the electrical undertaking. The acceptance, of course, is subject to the sanction of the Liverpool Corporation. The cause of Mr. Dickinson's appointment is said to be the inconvenience which has recently been caused to users of both light and power in Wigan, and also the difficulties in connection with the supply to the tramways. The fee to be paid Mr. Dickinson is £150.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Accrington.—The Corporation has decided not to duplicate the existing gas-engine plant as was intended, but to instal steam turbo-generators of a capacity of 4,000 kw. When the proposal came before the Council last week objection was taken to spending £16,000 in extensions at the existing power house, it being urged that it would be the better policy to build a new generating station. The scheme, however, was passed.

Bexley.—Mains extensions are to be carried out at an estimated cost of £300.

Watford.—An application is to be made to the Local Government Board for sanction to a loan of £3,300 for electrical supplies, required in connection with firms engaged on war contracts.

West Hartlepool.—Two water-tube boilers, with superheaters and mechanical stokers. Borough Electrical Engineer, April 28th. (See advertisement on another page.)

Miscellaneous

Australia.—A tramway company in South Australia has decided to spend £50,000 on electrifying the existing steam tramway. Further particulars at 73 Basinghall Street, E.C.

The Victorian Government Railways require a 2-ton electrically-operated goods elevator at Jolimont, Melbourne. Further particulars at 73 Basinghall Street, E.C. Tenders by May 17th. This information is only of value to firms who can cable agents.

Manchester.—The Guardians at Withington Infirmary require electrical materials in connection with the electric lighting of the main establishment. Clerk, Union Offices, All Saints, Manchester, April 17th.

APPOINTMENTS AND PERSONAL NOTES

Anticipating the calling-up of his Group, Mr. G. W. P. Page, who for the past two years was engaged chiefly on publication and other technical work in the Publication Department of the General Electric Co., Ltd., has enlisted in the London Electrical Engineers. Before joining the G.E.C. Mr. Page was on the Editorial Staff of Electrical Engineering.

Mr. H. G. White, who received a commission in the Royal Engineers last September, has now been promoted to the rank of Captain. Captain White was, previous to joining H.M. Forces, with Messrs. Gent & Co., Ltd., Faraday Works, Leicester.

Three electrical fitters are required for a factory in the London district (see an advertisement on another page).

A junior assistant is required at Barrow-in-Furness, and a junior shift engineer at Birmingham (see advertisements on another page).

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Cleveland and Durham Electric Power Company.—A dividend of 2 per cent. is proposed on the preference shares for 1915, adding £3,000 to depreciation and renewals fund, writing £1,000 off issue expenses, and carrying forward £8,575.

At the meeting last week it was pointed out that although the stability of the Company need cause no apprehension, its position had been affected by the war. Compared with 1913 there had been a diminution of revenue of £15,000, which could be traced solely to the war. In all the mining districts the output had been greatly reduced owing to the lack of labour, and there had been a substantial reduction in the demand from other businesses on the same account. The policy of the Company had been to have long term agreements, a perfectly sound one in normal times, but it left the Company in the position that it could not now ask for higher prices, notwithstanding that the costs of production have been so very much increased. The Board have decided that in future agreements for power supply, the price must vary according to the price of coal. One shareholder criticised the accounts, and asked for an inquiry into the position of the Company, but eventually the report and accounts were adopted, and the 2 per cent. dividend on the preference shares confirmed.

British Westinghouse Co.—The annual meeting was held in London on Thursday. The chairman, Mr. J. Annon Bryce, M.P., severely criticised the Excess Profits Tax, the policy of which, he said, is to make no distinction between profits made out of the war and profits made from normal business during the war, if the total profits of a company during the war exceed those of the twelve months prior to the war. In the case of the Westinghouse Co., he said, the larger profits of 1914, as compared with previous years, were not due in any sense to the war, but were actually smaller than they would have been had there been no war. Yet the Company would be called upon to pay to the Government one-half of the extra profits of that year. With regard to the general business of the Company, one order in 1915 amounted to £500,000, and was for the electrification of an important railway. Apart from this the orders showed an increase over 1914 of some 30 per cent., and a considerable part of this increase was probably due to the absence of German competition from which the Company had suffered so much in the past. Taken on the whole, the prospects as regards the Company were favourable.

Brush Electrical Engineering Co.—The accounts for 1915, after providing for debenture interest, show an available balance of £24,365, which is some £5,250 more than in 1914. Depreciation is credited with £8,000, as against £10,000 in the previous year, but £5,000 is also added to reserve. The dividend on the prior lien second debenture stock is again made up to 10 per cent., and the carry forward of £9,321 is an increase of £2,300 over 1914.

Ferranti's Foreign Trade.—We have frequently emphasised the necessity for expanding foreign trade, and it is with interest that we give the following list of recent orders received by Messrs. Ferranti, Ltd.:—France: Switchgear and transformers, £15,000. Denmark: Transformers and meters, £7,000. Holland: Switchgear and transformers (including 2/4,000 k.v.a.), £3,500. China: Meters, £8,000. Russia: Instruments and meters, £2,500. Spain: Meters, £1,500. Australia: Meters, £4,000. South America: Meters, £1,000. India: Meters, £1,500. Other countries: Meters, £2,000, making a total value of £46,000.

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £134 to £136 (last week £135 to £137).

ELECTRICAL ENGINEERING.

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Cheques to be made payable to The Kilowatt Publishing Co., Ltd., and to be crossed London County and Westminster Bank (Temple Bar Branch).

SUMMARY

The period for repayment of municipal loans in respect of storage batteries has been increased from seven to ten years (p. 139).

The seventh list of members of the Institute of Electrical Engineers serving with H.M. Forces is published, together with a list of those members who have received military decorations (p. 140).

At the Institution of Electrical Engineers, last Thursday, an interesting discussion took place on the present position of electricity supply in Great Britain. A paper on the subject was read by Mr. E. T. Williams, who advocated the setting up of a central Electricity Board, which should have administrative control as well as charge of the operation of electricity undertakings in this country. Opinion appeared to be divided as to the advisability from an engineering point of view of interlinking the supply stations throughout the country. Diverse opinions were also expressed as to the extent to which Government co-operation—or interference—should be looked for in the organisation of such a scheme. It was agreed, however, that to merit serious consideration, any proposed scheme must rest on a sound financial basis (p. 141).

Our "Questions and Answers" page this week deals with the re-winding of a 100-volt motor for a circuit of 500 volts (p. 142).

A remarkable system for automatically steering marine or aerial torpedoes to the object of their attack is described in a specification among those published at the Patent Office last Thursday. Other subjects dealt with include electric propulsion of ships and cables. Application has been made for extension of one of the Creed printing telegraph patents. A patent for strip lighting expires this week after a full life of fourteen years (p. 144).

Some interesting details are given of the applications of electricity to quarries in the 400 square miles area of the North Wales Electric Power Co. Hauling, drilling, and sawing are among the uses to which electric power is put (p. 145).

We give an illustrated description of a new line of small power motors, both A.C. and D.C., developed by the British Thomson-Houston Co., Ltd. (p. 145).

Dundee wiremen have been granted ½d. per hour increase against 2d. per hour asked for.—Experiments are to be carried out at Rhyl with the use of tar oil for Diesel engines (p. 146).

Extensions are to be carried out at Bermondsey (£1,162); Stepney (£19,000); Woolwich (£27,500); Wolverhampton (£17,160); Londonderry (£8,000); Accrington (£14,000); and Stoke-on-Trent. Mains are required at Wigan and Bedford, and boiler plant at Warrington (p. 146).

The South Wales Electrical Power Distribution Co. had a satisfactory year in 1915. An issue of £80,000 5 per cent. debentures has been made (p. 146).

ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEERS CORPS

Company Orders by Lieut.-Col. C. B. Clay, V.D.
Drills, 6.25 to 7.25: 7.25 to 8.25 p.m.

Fri., Sat., Sun., and Mon. (Easter): Training at Otford.
Tues., Apr. 25th: School of Arms, 6 to 7 p.m. Recruits' drill, 7.15 to 8.15 p.m.
Thurs., Apr. 27th: Shooting for Sections 3 & 4. Recruits, 5.45 to 7.45 p.m.
Fri., Apr. 28th: Sections 3 & 4, technical; Sections 1 & 2, squad and platoon. Signalling Class and Recruits.
Sat., Apr. 29th: Adjutant's Instruction Class at 2.30 p.m.
Sections for technical parade at Headquarters, London Electrical Engineers, 45 Regency Street, S.W.
Sections for shooting parade at miniature ranges.
Unless otherwise ordered, all parades at Chester House.

Killed in Action.—Sec.-Lieut. T. O. H. Bates, of the 89th Punjabis, late Chief Electrical Engineer to the Tata Steel and Iron Co., Bombay, India, died on the 12th inst. of wounds received in action in Mesopotamia. Prior to his appointment in India he held the position of Engineer-in-Charge at the Morley Corporation Electricity Works, and also Electrical Engineer at the Rotherham Main Collieries.

Municipal Loans for Storage Batteries.—The Local Government Board has, on an application made by the B.E.A.M.A., extended the period for the repayment of loans in respect of storage batteries from seven years to ten years, satisfactory guarantees being given.

Excessive Lighting at Electricity Works. The assistant engineer to an electric power station in the north-east coast district has been heavily fined for not obeying the instructions of the authorities as to the extinction of light on the night of April 1st. According to the evidence, all lights in the district were extinguished except those of the boiler-house at the electricity works. It was admitted that the instructions were received, but a lack of appreciation by the defendant of his duties was suggested. It may be mentioned that the man has lost his post in consequence.

What is Munition Work?—The case in which the granting of a leaving certificate to an employee by a Munitions Tribunal was appealed against in the High Courts, referred to on page 119 of our issue for April 6th, has been further argued before Mr. Justice Atkin, who gave judgment on Friday last. The Lincoln Wagon Co. objected to the granting of a leaving certificate to one of their employees on the ground that the man had been engaged on munition work, *i.e.*, repairing railway wagons, which it was stated come within the definition of war work as laid down in the Munitions of War Act. The Tribunal, however, took the view that as the man had during the last six weeks of his service been partly engaged in repairing colliery company's wagons and partly in wagon lifting, he had not during that period been employed on munitions within the meaning of the Act, and in consequence was entitled to a certificate. Mr. Justice Atkin, however, held that railway wagons of the class involved in the case were articles adapted for use in war as defined in the Act, and for this reason he decided that the view of the Munitions Tribunal that the man was not engaged on, or in connection with, munitions work must be reversed, and the certificate to that effect issued by the Tribunal set aside. On the other hand, however, the finding of the Tribunal was also based on the fact that a leaving certificate had been unreasonably refused. This, said his lordship, was a finding of fact which he had no power to review, and for that reason a certificate enabling the employee to accept other employment should be issued by the Court.

THE INSTITUTION AND THE FORCES

THE following rewards for service in the field to members of the Institution of Electrical Engineers are notified in the Institution Journal. A previous list was published in our issue of Feb. 10th, p. 48.

Military Cross.—Lieut. A. C. Sparks, R.E.

"For conspicuous gallantry and initiative when taking part with some infantry in a raid on the enemy's trenches. With a small R.E. party he made a very successful reconnaissance of the enemy's trenches and then exploded charges in two concrete structures."—*London Gazette*, March 15th, 1916.

Mentioned in Dispatches.—Major A. S. Angwin (Lowland Signal Service, R.E.); Captain H. Carey-Thomas (London Army Troops, R.E.); Major L. Evans (R.E.); Lieut. R. K. Morcom (Divisional Engineers, R.N.D.).

We give below the seventh list of members of the Institution of Electrical Engineers who are serving with H.M. Forces. Previous lists appeared in ELECTRICAL ENGINEERING for Jan. 21st, Feb. 18th, March 4th, and July 15th, 1915, and Jan. 6th, Feb. 10th, and Feb. 17th, 1916.

Members.—Lieut.-Col. D. S. Capper (London University O.T.C.); H. E. M. Kensit (Canadian Engineers); Lieut. E. H. W. Westwood (Australian Imperial Force).

Associate Members.—F. C. Baumann (London Elec. Engineers); J. R. Bedford (Anti-Aircraft Corps, R.N.A.S.); F. Birch (Manchester University O.T.C.); Eng. Sub-Lieut. J. B. Bullock (R.N.); Sec.-Lieut. S. W. Carty (A.S.C.); Sub-Lieut. C. C. Casperd (R.N.V.R.); E. Clark (Australian Imperial Force), A. E. Clayton (London Elec. Engineers); H. G. Y. Crowder (Canadian Field Artillery); Sec.-Lieut. W. H. Date (R.F.C.); Sec.-Lieut. N. Denison (East Anglian R.E.); J. C. Eadie (British Red Cross); Sec. Lieut. W. G. Hamilton (R.E.); Lieut. F. T. Hewson (R.N.); G. Ingram (London University O.T.C.); A. M. Johnson (R.F.C.); Sub-Lieut. T. S. Lacy (R.N.V.R.); T. H. Langford (Artists' Rifles O.T.C.); Sub-Lieut. F. G. Matravers (R.N.); T. S. Midgley (A.S.C.); T. G. Partridge (Punjab Light Horse); Lieut. F. C. Poulton (A.O.C.); W. D. Redfern (East Lancs. Field Ambulance, R.A.M.C.); Lieut. T. A. Ross (R.E.); Sec. Lieut. A. D. Taberner (Loyal North Lancashire Regt.).

Associate.—J. O. Ince (Anti-Aircraft Corps, R.N.A.S.).

Graduates.—L. D. François (R.E.); A. Smellie (London Elec. Engineers); Capt. R. B. Walker (Yorkshire Hussars Yeomanry).

Students.—R. G. Burton (Artists' Rifles O.T.C.); E. S. Cheel (Artists' Rifles O.T.C.); W. B. Coulthard (London Elec. Engineers); Lieut. M. L. Delanoy (R.E.); Sec.-Lieut. P. H. Denton (R.E.); F. Dixon (Lancashire and Cheshire R.G.A.); E. T. Driver (Artists' Rifles O.T.C.); Sub-Lieut. F. W. Fisher (R.N.V.R.); A. M. Jenkins (London Elec. Engineers); F. H. Lawrence (Officers' Cadet Unit, R.F.A.); Sub-Lieut. F. C. Lunnon (R.N.V.R.); A. T. Mahon (L.R.B.); Lieut. F. A. P. Perrow (South African Medical Corps); Sergeant A. H. Rowles (Cornwall (Fortress) R.E.); Sergeant L. H. V. Webster (R.E.).

Institution of Electrical Engineers.—The following is the result of the ballot for new members, and for transfers from one class to another, at the meeting on Thursday:—*Associate Members*—J. C. Briggs, E. Forder, H. R. Forrest, T. A. Kingham, J. J. Loftus, D. McDougall, Corporal G. A. Partington, R.E., A. J. Pettie, R. Stanley-Smith, W. E. Watson. *Students*—G. E. Barton, J. I. Bernard, V. A. Brown, W. E. Doran, H. A. Fichzon, C. B. Gee, F. Greenwood, W. A. Long, A. M. Mehrez, T. Milnes, S. O. Pearson, R. H. Rawll, E. W. Simpson, A. R. Smith, O. V. Waddington, C. F. Wormull. CANDIDATES TRANSFERRED.—*From Associate Member to Member*—J. S. St. George Cooper, 2nd Lieut. C. N. Hamilton, R.G.A., P. Olver, J. H. Wright. *From Graduate to Associate Member*—L. W. Barsdorf, J. W. Beck, W. S. Browne, R. G. Campbell, W. D. Douglas, H. C. Healey, R. G. Jones, B. J. Leggett, B. McCormick, Major E. A. Pells, RE., D. D. Rayner, J. W. Rodger, W. S. Sawtell, A. Smellie, Jun., T. F. Stent, H. P. Young. *From Student to Associate Member*—W. R. Abram, F. Goble, H. Gregson, H. Hobson, W. G. Johnson, B. A. Robinson, J. C. Wilson.

Storm Accident.—An action of some interest to those responsible for maintaining overhead electric supply wires was heard at St. Austell last week. It appears that during a storm on December 27th one of the poles carrying overhead wires belonging to the St. Austell Electric Lighting and Power Co., fell into the roadway and caused injuries to a mail-cart postman and his horse. The company pleaded that the accident was an act of God, but on the evidence the County Court judge dismissed this plea, and found that the accident was due to negligence, the evidence of the plaintiff being that the pole was rotten. The judge held that the company had no proper system of testing the strength of their poles at regular intervals, nor of keeping any records of such tests. At the same time, the public who used the roads were entitled to security.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Overhead Transmission Lines and Distributing Circuits: Their Design and Construction. By F. Kapper. Translated by P. R. Friedlaender. 300 pp. 10¼ in. by 7½ in. 297 figures. (London: Constable & Co., Ltd.) 16*s.* net; abroad, 17*s.* 1*d.*

THIS is a good translation of a modern German book on the subject, being principally devoted to the necessary calculations and design for overhead transmission lines. The translator has done his work thoroughly, for British measures are used throughout, and the diagrams have in many cases been re-drawn. In some of the drawings and diagrams, it is true, a left-hand draughtsman has apparently been employed, so that the lettering and dimensions on the vertical lines appear upside-down; this is more disturbing than one would expect, when, for instance, it is necessary to work out formulæ against a diagram, but we suppose that allowances must be made in the case of a book published in war-time. British engineers have only limited practical experience to go upon in the design of overhead transmission lines, and, in consequence, they can learn much from American and German methods, so the book before us will certainly be useful.

Telegraph Engineering: A Manual for Practical Telegraph Engineers and Engineering Students. By E. Hausmann. 406 pp. 8¾ in. by 5¾ in. (London: Constable and Co., Ltd.) 12s. 6d. net; abroad, 13s. 4d.

IT would perhaps be hypercritical, in reviewing a book on telegraphy written principally as a manual for American students and telegraph engineers, to criticise the Author for giving all credit for the initiation of the telegraph to Morse and none to Wheatstone, and for omitting all mention of the needle and "ABC" instruments, and for mentioning the Hughes only by name. The Author explains his subject clearly and well, the diagrams are excellent, and the subject of modern telegraphy is well covered on the whole, remembering always, however, that American practice is naturally considered the more important. In the chapters on printing telegraphs, the Barlay, which is extensively used in the United States, is selected for fairly detailed description, and a shorter account of the Murray is given, but no details are given of the Creed or Baudot. A few pages are devoted to telephotography, and the Korn system, which is described, it is said, "is in successful practical operation over several long-distance lines," nothing being added to indicate that telephotography has not entirely emerged from the experimental stage. A description of the induction telegraph used by the United States Army is interesting. Several railway signalling systems are dealt with, there is a chapter on fire alarms and police telegraphs, and the book concludes with a chapter on the theory of current propagation and one on submarine telegraphy.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

Replying to a question in the House of Commons last week with regard to the interruption in the telegraphic system of the country during the recent storm, Mr. J. A. Pease stated that the importance of securing uninterrupted telegraphic communication by means of underground lines had been kept in view by successive Postmasters-General, and an underground telegraph system which cost about £2,000,000 is now in use. Taking the telegraph and telephone systems together, the total length of aerial wire in use is now less than 1,000,000 miles, as compared with over 2,000,000 miles of underground wire. The cost of putting the remaining trunk telegraph lines underground would probably exceed £3,000,000, and the annual charge for interest and depreciation, taken at 6 per cent. only, would be £180,000 a year, as compared with an average annual cost for storm repairs for the past 10 years of £24,190, of which £6,793 has been in respect of the main trunk telegraph lines. It would, moreover, be impossible to carry out this work at present. Owing to the shortage of labour and other circumstances connected with the war, it has been necessary to suspend the schemes in progress for the construction of additional telegraph and telephone underground lines.

THE ELECTRICITY SUPPLY OF GREAT BRITAIN

Proposed Electricity Board

AT the meeting of the Institution of Electrical Engineers last Thursday, a Paper was read by Mr. E. T. Williams, initiating a discussion on the question of the co-ordination of the control and operation of the electricity undertakings of this country. The time has now arrived, said Mr. Williams, when we must think of the supply industry not as a large number of independent detached schemes having separate areas, but for the country as a whole. The same circumstances and arguments which have caused the evolution in successive stages in the past can be applied with equal or greater force to the next stage. If the policy of centralising the generating plants in larger power stations has been economically sound, even though this involves transformation losses and additional mains, then why should we hesitate in taking the next logical step of considering the eventual replacement of the large number of small, costly, comparatively inefficient electric supply stations by a few modern interconnected power stations for dealing with the electricity supply of the country as a whole?

The public control of electricity supply is at present vested directly in Parliament, in the Board of Trade, in the Local Government Board, and in the Home Office. It is desirable for the highest success of our scheme as a whole that this control shall be co-ordinated by a central body directly responsible to Parliament. It is most desirable that such a body shall not be an existing Government Department having various other interests; also that it shall not be a Government Department at all in the accepted sense of the word and acting under the multifarious restrictions with which Government Departments are essentially bound. At the same time this central body must have all the weight of Government authority and be able to authorise or raise big loans on Government security at low rates of interest.

Suffice it to say that there does not exist at present such a body, and that one would have to be created with the necessary powers under Special Act of Parliament. Such a body could be designated the Electricity Board, and by it could be controlled the whole of the electricity supply problems of the United Kingdom. The *raison d'être* of such a board would be the co-ordination, control, and development of the electricity supply of the whole kingdom for the public good.

The constitution of such a Board would be important, and in order to consider more clearly what its composition and scope would be, we may assume that the whole country of Great Britain is divided into, say, six sections, viz., the South-East (including London), the South-West, the Midland, the North-East, the North-West, and Scotland. Whether this is exactly the most suitable set of divisions matters little for the purposes of this Paper, but it forms a basis on which the whole scheme can be considered.

An electrical engineer manager would be appointed for each district, where he would reside in a central position. On him would devolve primarily the responsibility of seeing that the best interests of the electricity supply for the public good were being developed and maintained, and in him would be co-ordinated the various electrical interests of the district and the management of such portion of the electricity supply as might be directly handled by the Electricity Board.

One of the most interesting examples of a new quasi Government Department is that of the Public Trustee, whose great and rapid success proved the value of having a faithful and sympathetic public servant available for certain purposes. The electrical engineer managers would act in a similar way in their own districts, whose electrical well-being would be their primary interest and endeavour, and these gentlemen holding well-paid and authoritative positions would be members of the Electricity Board and take part in all its deliberations.

Such public Boards to be most efficient should be kept as small in size as possible. It is, however, desirable that they shall be self-contained and fully representative of the departments of the Board. Such departments would be the legal, the accounting, the financial, and the Parliamentary. The legal would deal with all legal questions coming under the purview of the Board or its electrical engineer managers, who would have the value of direct and free appeal to the responsible legal authority at all times. Similarly, the importance of audit and accounts which would come under the Board in many ways would make this an important department. The vast financial interests, the raising and repayment of loans, and other financial transactions would necessitate a financial department. The Parliamentary representative would be a sitting Member of Parliament who would represent Parliament on the Board and the Board in Parliament and deal generally with Government Departments. The heads of these four departments, like the electrical engineer managers, should be men of authority and repute in their several professions, so that the Board constituted of these ten and two other members, would represent an efficient and responsible body of high permanent officials and recognised experts.

It would be desirable that the President of the Board, at the outset at any rate, should be a man of wide knowledge and experience in public affairs, and a man whose name carried weight and confidence with the public and men of affairs. Like the other members, he should preferably be a paid official and expected to devote most of his time and interests to the work of the Board. Finally, the Board would have its permanent Secretary in whom—under the President—the organisation would be centralised.

To the Electricity Board proposed in the foregoing clauses all the questions relating to the electricity supply of Great Britain would be referred. It would become the Authority—under Act of Parliament—on all the various questions and issues involved in the supply and application of electricity. Matters now dealt with by the Home Office, the Board of Trade, the Local Government Board, and by Parliament itself, would be gathered together under its control. The only reservation would be the right of appeal from the Board's decisions to the higher authority of Parliament.

It should be clearly understood that our proposed scheme is not for the nationalisation of electricity supply, nor is it for the municipalisation of that supply Its true function is the co-ordination into one body of the control of the electricity supply, assisting existing undertakings, whether municipal or company owned, and taking upon itself only those functions of generation and distribution which are essential to the furtherance of wise development and a supply at the lowest cost.

It should also be clearly understood at the outset that our scheme proposes no confiscation of the rights, privileges, and property of either electricity companies or municipalities, and in the event of its being recognised as essential in certain special cases to take any of these over, that full compensation shall be paid not only of the value of the actual plant, but of reasonable allowances for potential values. This course is considered to be the only sound, logical, and equitable one; for while on the one hand it will prevent a number of undertakings with obsolete plant being put as a burden on to the shoulders of the Board, on the other it will remove all fear of unfavourable or detrimental treatment from those authorities or companies who have been successfully working for present and future results.

In order that these principles shall be ensured, they would be embodied into the proposed Act of Parliament under which the Board would be formed and would act. In other words, it is not proposed to set up an arbitrary organisation which will act as though the present state of the electrical industry required radical and sweeping changes and the overcoming of existing interests—*no*—rather the whole basis and policy of the organisation will be heartily to recognise what has been done by the existing authorities, whether public or private, and, instead of sweeping away, to conserve and build up, guiding future policy and co-operating with the present authorities for the well-being of the whole.

The discussion was opened by Mr. C. H. Merz, who regretted that Mr. Ferranti was not present, as he had put forward, twenty years ago, an ideal similar in principle to that now proposed by Mr. Williams. During the last twenty years we had had some such ideal more or less continually before us, and yet no progress had been made towards its attainment. Why was that? It was the business of the Institution primarily to settle the technical aspect of the question. The author had stated that technically the scheme presented no difficulties, but he took a different view. The Institution should definitely face the problem. In the first place, we ought not to argue from the practice of other countries; what was good for the States or Germany was not necessarily good for us; it was really a matter of geography, and our geography was unique. Our aim must be to lead, not to follow. One of the most important things to be considered in electricity supply was security of supply, and he doubted whether this would be increased by an all-round linking up of stations: it would be putting all our eggs in one basket. He quite admitted, however, the greater economy resulting from larger stations and units. The first thing which might be done to improve the position of electricity supply in this country was to do as had been done in America, namely, to create a "fashion" amongst consumers throughout the country to take a public

supply. This was a point of great importance, and would be a great step forward.

Mr. R. A. Chattock approved generally the scheme suggested by Mr. Williams. He himself had made similar recommendations two years ago before the Incorporated Municipal Electrical Association. Everything turned, however, on the necessity of attracting consumers. He could not agree with Mr. Merz about the creation of a mere fashion. Deeper reasons were necessary to attract consumers, who considered price and security of supply. The present supply in this country was about one-tenth what it might be. Any general scheme should be conceived on very broad-minded lines, not from the point of view of immediate profit-making. Uneconomical stations should be cut out, as generating units. He thought there might be difficulty in obtaining wayleaves for the trunk lines for a big scheme; drastic powers would have to be sought, or such difficulties would cripple the scheme. The Institution ought to have a cut-and-dried scheme ready for consideration by Parliament at a suitable opportunity.

Mr. J. S. Highfield, with reference to the remarks of the last speaker on the financial question, said that it would be a mistake to go back to the old days when supply authorities congratulated themselves on a gross return of 4 per cent. on their capital. It would be hopeless to attempt to raise money if the scheme was not put on a sound financial basis. He agreed with Mr. Merz as to the necessity of setting up a fashion amongst consumers in taking their supply from a public authority. He did not approve of any Government interference in this matter. Legislation had not always proved a good thing, as was instanced by the railway companies and the gas companies. With regard to the Board proposed by Mr. Williams, he was not quite sure what its construction was. To whom was it to be responsible? It looked as though the Board was to be invested with two powers, those of control and operation, which were mutually destructive. If they eliminated the power of operation, he believed the proposed Board would then be a good thing.

Mr. H. Faraday Proctor said that there certainly appeared to be some need for uniformity if we looked at the variation in prices charged for supply, say, in London alone. He thought the formation of the proposed Board was good; some independent body was needed. If the matter had been undertaken by the Institution, for example, there would have been too many personal interests. He made further remarks expressing his general agreement with the proposals of the author.

Mr. W. B. Woodhouse agreed with Mr. Merz as to the necessity for engineers coming to some definite conclusion in the first place. The subject of electricity supply was only one link in the larger question of the fuel conservation of the country. Financial security was certainly essential to any scheme. In these democratic days the first step necessary was to educate the public to appreciate the present position of electricity supply. No Government assistance or progress could be obtained until that was done.

Mr. C. H. Wordingham deprecated any Government interference whatever, and said he certainly agreed with Mr. Highfield that the first essential to any scheme was that it must be financially sound.

Mr. W. L. Madgen said the author had made reference to the Hydro-Electric Commission in Ontario as being a body with somewhat similar powers to that which he proposed. He had had personal experience with that Commission, and he knew of no more reprehensible body in existence. It possessed powers of both operation and control, and the result had been that small companies had been completely eliminated.

Mr. T. Roles differed from Mr. Merz in that he believed that engineers are in agreement on the technical aspect of the question. No member present would deny it if he were offered one of the positions as engineer-manager at £2,500 a year, suggested by the author. He agreed with the author that the human factor was the main consideration in the question.

The President announced that the author of the Paper reserved his reply for a written communication.

War Bonuses and Piece-work Systems.—A novel method of fixing piece rates, by which a bonus is based on the time taken for a job, not on the time saved, was described by Mr. R. Rankin at a meeting of the Junior Institution of Engineers on April 18th. The system, which is said to have been very successful, is as follows:—The amount of work which can be done per hour by a good worker, working at a good pace, is ascertained and taken as a base to work on. The amount he does in one hour is set as the task which it is expected will be done, and a definite rate of pay is decided upon for this rate of working. This percentage was fixed at 20 per cent. If the task is done in less than an hour, the workman gets one hour's wage at the base rate plus an amount, at the base rate, corresponding to 20 per cent. of the actual time taken to do the task. If the task takes longer than an hour, the man is paid at the base rate for the time actually taken plus a bonus equal to an amount, at the base rate, corresponding to a fraction of the time actually taken, this fraction being 20 per cent., when exactly one hour is taken for the task, and vanishing when the time taken reaches some predetermined period in excess of an hour. The point at which the bonus becomes zero was fixed at an hour and twenty minutes. If more than one hour and twenty minutes is taken, the base rate alone becomes operative, no bonus being payable.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

QUESTION No. 1,491.

If a three-phase turbo-alternator is short-circuited at its terminals when running, a very large current will flow, the amount of which depends chiefly on the inductance of the stator winding. If full particulars of the machine are known, is it possible to determine approximately the value of the instantaneous short-circuit current? If so, please state clearly the method of doing it. How long could the short be left on without damaging the alternator, and what is the maximum value of the current which would not damage the stator winding?—B. M. S.

(*Replies must be received not later than first post, Thursday, April 27th.*)

ANSWERS TO No. 1,489.

I have a $1\frac{1}{2}$-h.p. shunt-wound 4-pole 100-volt motor that I wish to re-wind for a circuit of 500 volts. The armature is wave wound with a triplex winding, 29 slots, each slot containing two former wound elements, each element comprising three coils of four turns of No. 13 d.c.c. wire. The dimensions of the slot space occupied by the winding are $0.35'' \times 0.832''$. There are 87 commutator segments. Each field coil consists of 1,020 turns of No. 17 S.W.G., d.c.c. wire, and has a resistance of 8.62 ohms. It has been suggested that the armature should be re-wound "simplex." Give particulars of suitable windings for the field and armature, and state, if it is necessary to supply a new commutator, the least number of commutator segments necessary to obtain satisfactory working.—"CONVERTER."

The first award (10s.) is made to "Koil" for the following reply:—

A triplex wave-wound armature has six paths in parallel, and a simplex wave has only two. Consequently other things remaining the same, the change in connections from triplex to simplex effects an increase in the back electromotive force of 3 to 1. In the case under consideration, the desired increase is about 5 to 1 (the internal volts drop being considered as proportional to the applied voltage which is sufficiently accurate for present purposes). The total number of bars on the armature must therefore be increased in the ratio of 5 to 3, in addition to the change in connections. From the figures given there are $29 \times 3 \times 4 \times 2 = 696$ coil sides or bars at present on the armature. These must be increased to $\frac{5}{3} \times 696 = 1{,}160$, say 1,150 active bars.

Simplex connections make the resistance per path $(6 \div 2)^2 = 9$ times as great as triplex windings, but for the same copper losses in the armature, the resistance at 500 volts may be $(500 \div 100)^2 = 25$ times as great as at 100 volts, assuming that the armature current is inversely proportional to the volts. Thus the product of the total number of armature bars in series per path multiplied by the area of each bar may in this case be reduced in the ratio of 9 to 25.

The present wire is $\cdot092''$ diameter. Therefore the new wire should be $\sqrt{\cdot092^2 \times \frac{9}{25} \times \frac{1150}{696}} = \cdot071''$ diameter. The nearest smaller standard wire gauge to this is No. 16 ($\cdot064''$ diameter), and if each of the elements be wound with four coils each of five turns of this size of wire, there will be a small margin in space for extra slot insulation beyond what is already provided. Thus, allowing $\cdot012''$ increase in diameter for the d.c.c. covering, we have at present $(\cdot092'' + \cdot012'') \times 3 = \cdot312''$ wide, $(\cdot092'' + \cdot012'') \times 8 = \cdot832''$ deep. The new wire will give $(\cdot064'' + \cdot012'') \times 4 = \cdot304''$ wide, $(\cdot064'' + \cdot012'') \times 10 = \cdot760''$ deep.

It will be noticed that in the above figures it is assumed that the wires will bed in square formation, and it is important

that the armature be so wound that all sides of one coil lie directly beneath each other, and are thus in the same relative position during commutation.

The above new winding gives $4 \times 29 = 116$ coils, which will necessitate the provision of 115 commutator parts, one coil being idle. The connections should be

Back   8A and B   22C
Front   1A and B /   \ 15C /   \ 29D etc.

Where 1, 8 and 15 represent the slots, and A, B, C, and D the position of the coil ends in the slots numbering from left to right, the winding starting at the bottom left-hand side of slot 1, and going to the top of slot 8 at the back end of the armature. (It will be noted that the idle coil is dealt with by the first connection, and after this the connecting is quite straightforward.) One hundred and fifteen commutator bars give an average of about 8·7 volts between segments, which in consideration of the small current per path should prove satisfactory, but from the data given it is not possible to state definitely whether good commutation will be obtained with this number of bars. The resistance of the armature as compared with the present winding will be $9 \times \frac{1150}{696} \times \left(\frac{\cdot 092}{\cdot 064}\right)^2 = 30\cdot 75 : 1$. Therefore for the same copper watts, the armature current can be $\sqrt{\frac{1}{30\cdot 75}} = \frac{1}{5\cdot 55}$ of the current at 100 volts, which enable $\frac{5}{5\cdot 55} \times 1\cdot 5$ B.H.P. $= 1\cdot 35$ B.H.P. to be taken from the motor for the same armature heating.

The size of wire for field coils should be $\sqrt{\cdot 056^2 \times \frac{100}{500}} = \cdot 025''$ diameter ($\cdot 056''$ being the diameter of No. 17 S.W.G.). The nearest larger standard wire gauge to this is No. 22 ($\cdot 028''$ diameter). Using this, the number of turns for the same weight of copper is $\left(\frac{\cdot 056}{\cdot 028}\right)^2 \times 1020 = 4080$ turns. Single cotton-covered wire should be satisfactory provided the lead from the inside of the coil is well insulated, and the space factor obtained with this will be about as good as with the smaller number of turns of D.C.C. wire. The resistance of the coil will then be $8\cdot 62 \times \left(\frac{\cdot 056}{\cdot 028}\right)^2 \times \frac{4080}{1020} = 138$ ohms. The present coil (if no resistance is used), will give $\frac{100}{8\cdot 62} \times 4 \times 1020 = 2960$ ampere turns per pole. For these ampere turns, the new coil will require $\frac{2960}{4080} = \cdot 725$ amperes, which will absorb $\cdot 725 \times 4 \times 138 = 400$ volts, leaving 100 volts to be taken up by regulator or permanent resistance.

A combination of Nos. 22 and 23 S.W.G. wire could be used to give exactly the correct number of ampere turns at 500 volts without the use of any external resistance. This is not altogether satisfactory, as the heat is unequally distributed, two sizes of wire have to be obtained, and the number of joints is multiplied; in view of the low cost of, and the advantages obtained by, having a regulator in circuit, the complication is not warranted.

The second award (5s.) is made to "Y. Z." We give his reply in abridged form :—

Since there are 87 commutator segments, each corresponding to four turns of the winding, and since the winding is a triplex one, the commutator pitch must be $y_k = (87 \pm 3)/2$, since there are two pairs of poles. This gives 45 or 42 for y_k in the present winding. Since 87 and 3 have the common factor 3, the winding closes thrice, being, therefore, of the type 000. There are thus three entirely distinct windings on the armature in parallel with each other, each consisting of $87 \times 4/3$, or 116 turns, wave wound, and the equivalent number of turns on the whole armature is therefore just this number, 116. This at once shows that if the armature be rewound with $116 \times 5 = 580$ turns, the desired result will be obtained, since it may be assumed that the proportionate drop in volts, which determines the back electromotive force of the armature under the two conditions, will remain unaltered. The armature, having its turns and back electromotive force increased both five-fold, will run at the same speed on the new voltage. The total winding space in the slot is given as $0\cdot 35'' \times 0\cdot 832''$, so that the space for one element, with twelve wires in it in the 100 volt winding, is $0\cdot 416''$ high $\times$ $0\cdot 35''$ wide. As the size of copper is $0\cdot 092''$ diameter, presumably this means that the wires are arranged four in height and three in width. Now the new winding is to have 580 turns, or 1,160 conductors, which means 40 conductors per slot, or 20 per element, on the assumption that the new winding is to be an ordinary two circuit, so-called "simplex" wave winding. The new winding can be arranged five in height and four in width in the space $0\cdot 416'' \times 0\cdot 35''$, allowing a space of $0\cdot 0832'' \times 0\cdot 0875''$ for each wire and its covering. Allowing for a little more slot insulation than before, on account of the higher voltage, $0\cdot 072''$ (No. 15) is perhaps rather tight, and $0\cdot 064''$ (No. 16) is unnecessarily slack. So use $0\cdot 068''$ (No. 15½ S.W.G.) d.c.c. wire for the new winding.

The slot pitch of the winding, on the core, will be, of course, the same as before, but the commutator pitch must now be such that it makes only one pair of circuits instead of three. Its actual value is found later. The section of copper in the new winding is $\frac{\pi}{4} \times 0\cdot 068^2$, corresponding to an existing section of $3 \times \frac{\pi}{4} \times 0\cdot 092^2$, which means the new section is 0·182 of the old. There are five times as many turns on this basis, so that the resistance of the new winding is $5/0\cdot 182 = 27\cdot 5$ times that of the old. The new armature current is, however, only one-fifth of the old, so that the drop in volts is 5·5 times what it is now, instead of being 5 times.

The 580 turns are to be arranged in 29 slots as before. Each element containing 20 wires, this means that the number of commutator parts may be 29, with 20 turns each; or 58, with 10 turns each; or 116, with 5 turns each; or 145, with 4 turns each; or 290, with 2 turns each; or 580, with 1 turn each, as a mere matter of arithmetical possibility. The first two, 29 and 58, are obviously too few; and the last two, 290 and 580, are far too many for the size of commutator belonging to a machine of this size. The present number, 87, is entirely excluded: it might be used if 21 wires per element were used, as that would give 7 turns per commutator segment; but 21 wires would not arrange very nicely in the slot, and in any case 87 segments on a 500-volt machine of this output, without interpoles, is almost certain to be too few. It is not possible to give an exact decision on this point, as the data are insufficient, and one must therefore go by experience, and say that if the output be really 12 or 15 h.p. the number of segments should be 116 or 145, and preferably the latter, unless the dimensions of the commutator are such that the size of the segments becomes unmanageably small with this number. In that case the smaller number would be used, and the actual number would be 115, not 116, since for the usual four-pole wave-wound connection the number of segments should be odd. There would therefore be a dead coil in this winding, but not in the 145 part winding. This is no place for a general discussion of reactance voltage, but it may be said that if 145 segments be used on 500 volts, the present winding having an equivalent of 29 segments for 100 volts, or just a fifth of the number, the new winding should be at least as good as the old winding in regard to commutation, more especially in view of the difficulty of getting a triplex winding of the sort used here to work well under any circumstances. It will no doubt be necessary to use thinner brushes with the new winding. At present it is to be presumed that the brushes cover 4 or 5 segments; if now they be made to cover 2 or 2½, the segments being only three-fifths as thick, if 145 be used, the thickness of brushes should be reduced to (2 or 2½)/(4 or 5) of three-fifths, or 0·3 of their present thickness. This means the brush contact density is reduced, since the new current is 0·2 only of the old, which will suit the harder carbons which presumably will have to be used.

The commutator pitch, if 145 segments be used, would be $y_k = (145 \pm 1)2 = 73$ or 72, and if 115 segments be used, would be $y_k = (115 \pm 1)2 = 58$ or 57.

This armature will therefore, if the flux be kept the same, or nearly so, run at approximately the same speed as the present one, will be very little hotter, and will commutate at least as well.

Field Winding.—If the ampere turns on this can be kept the same as at present, the flux will be unchanged, and the conditions of the problem are fulfilled. The new size of wire may be got thus: The ampere turns are given by Et/w, where E is exciting volts, t is total turns, and w is total ohms of field winding. But w is proportional to t/area of wire used, as long as the length of mean turn is unaltered. Hence ampere turns $\propto Et \times$ area of wire used$/t$, or $\propto E \times$ area of wire used. Hence for constant ampere turns, the new area of wire must be one-fifth of the present area, or, if d be its diameter, $0\cdot 2 \frac{\pi}{4} d^2 = 0\cdot 2 \frac{\pi}{4} \times 0\cdot 056^2$, since No. 17 S.W.G. is 0·056 diameter. Hence $d = 0\cdot 056 \times \sqrt{0\cdot 2} = 0\cdot 025$. Using 0·024, which is No. 23 S.W.G., will give slightly fewer ampere-turns, but as the space factor for smaller wires is less favourable, it is better to take a slightly smaller wire, unless the present winding is cooler than need be. The number of turns may be taken as inversely proportional to the squares of the covered diameters of the wires, and these are 0·068 and 0·034 respectively, using ordinary coverings of 12 and 10 mils. Hence the new number of turns is $1{,}020 \times 0\cdot 068^2 / 0\cdot 034^2 = 4{,}080$ per coil. The resistance, as has been said, varies as t/area, so the new resistance is $8\cdot 62 \times 4{,}080/1{,}020 \times \frac{\pi}{4} \times 0\cdot 056^2 / \frac{\pi}{4} \times 0\cdot 024^2 = 188$ ohms. Hence the new winding is 4,080 turns of No. 23 S.W.G., d.c.c. wire, with a resistance of 188 ohms, for each coil. The present ampere turns are $(100/4 \times 8\cdot 62) \times 4 \times 1{,}020$, or about 11,800. The new ampere turns are $(500/4 \times 188) \times 4 \times 4{,}080$, or about 10,800. This reduction should not cause more than 5 per cent. increase in speed at the outside. The present watts in the field coils are $(100/4 \times 8\cdot 62)^2 \times 8\cdot 62$, or 72·5 watts per coil. The new watts are $(500/4 \times 188)^2 \times 188$, or 83 watts per coil. This is 15 per cent. additional, or 10 per cent. on a present basis of 70 per cent.

This is probably all right, but if not, more wire of the same size may be wound on. This will slightly increase the length of mean turn, and, in consequence, slightly decrease the ampere turns, but the change will be small. Should the present temperature rise be reasonable, there will be no need to use more wire, and the coils will therefore be somewhat hotter. The slight reduction in flux and consequent increase in speed will be associated with a slight diminution in armature iron loss probably; the result of this has already been referred to in connection with armature heating.

War Tribunals.—Mr. J. B. Crowther, electrical engineer to the Worksop Council, last week asked the local tribunal for leave to withdraw his application for exemption. Mr. Crowther has joined the Electrical Corps of the Royal Engineers, as stated elsewhere. The tribunal, however, granted temporary exemption to the station superintendent at the works, and also to two stokers, the cable jointer and the fitter. The only single employee concerned, the meter-tester, has been put back until September 1st. At Maidenhead, six months' exemption was granted to six employees of the Electricity Department, Mr. C. O. Milton, the borough electrical engineer, conducting the case for the Corporation. Exemption until the end of May has been granted to the electrician and bioscope operator at the Warrington Hippodrome. An electrician employed by a London electric supply company has asked for total exemption on the ground that he is engaged in the supply of current to the tramways, and in consequence is in a reserved occupation. The Military Representative said it was a moot point as to tramways being of national service, but the authorities granted conditional exemption for three months. An electrical engineer employed by Messrs. Siemens Bros. & Co., who has charge of the running of a large new plant at a paper works, was put back, as he had not undergone the Army medical examination. The Douglas (I.O.M.) Tribunal has exempted the electrician in charge of the Government electrical plant there so long as he remains in his present employ.

Electrical Refining of Zinc.—According to His Majesty's Minister at Christiania the electrical refining of zinc has been developing on a gradually increasing scale at Trollhattan for some years past, and has now reached an output of over 6,000 tons of refined zinc per annum. The ore is first smelted in the raw material furnaces and the ordinary spelter thus produced is then re-distilled in the refining furnaces. Refining is also being carried on at Sundlokken. For some time past plans have been discussed for increased facilities for smelting the ore, and it has now been decided to secure the necessary water power from the Glomfjord waterfalls, situated in Nordre Helgeland, in Nordland. These falls have been purchased by a company formed for the purpose, and when fully developed are calculated to yield 125,000 h.p. The works are expected to be completed by 1918, and the hydraulic power obtained will be used for smelting the ore and the refining process connected therewith.

The Ministry of Munitions and Power Requirements.—In the House of Commons last week, Dr. Addison, speaking on behalf of the Minister of Munitions, stated, in reply to a suggestion that a limit should be placed upon the use of electricity and gas for lighting purposes, that care has been taken that the requirements of munition factories shall rank before all other considerations.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published April 13th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

2,841/15. **Electric Propulsion of Ships.** B.T.-H. Co. (*G.E. Co., U.S.A.*). A system of electrical ship propulsion employing more than one A.C. induction motor of the pole-changing type supplied with current by steam turbine-driven alternators. The control is effected by a single controller, so interlocked that the operations must be carried out in the correct order, which acts upon the motor connections, generator field, and turbine throttle governor. (Five figures.)

4,032/15. **Steering of Torpedoes.** W. J. Cook. An automatic control gear for torpedoes, enabling them to proceed and attack any vessel within a certain zone of action as it comes into view. The "eye" of the torpedo is an instrument resembling a camera, with the image thrown on to a sectionalised screen composed of selenium cells. As long as the cells are approximately equally illuminated no effect is produced, but on the darker image of a ship upsetting the balance of their resistance, certain relays are actuated releasing the torpedo, if moored, or increasing its speed if travelling, and steering automatically towards the object. It is also proposed to control self-steering aircraft in a similar way to effect attack on hostile airships, &c., in daylight. (Ten figures.)

4,138/15. **Cables.** H. Terry & Sons and C. Terry. A cable in which the insulating material is protected by a metal sheathing covered by a waterproof material composed of a mixture of nitro-cellulose and other nitro-compounds. (One figure.)

16,900/15. **Cables.** J. H. Bowden and H. F. J. Thompson. Multicore cables with symmetrically arranged conductors separated by a conducting shield of such a shape that all portions are neutralised in regard to the inductive field due to the current-passing into the main conductors. (Four figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: Moore [Carbon ferrules] 1221/15.

Dynamos, Motors and Transformers: Soc. Anon. des Etablissement, L. Bleriot [Dynamos] 882/15.

Heating and Cooking: Smith [Liquid heaters] 17,411/15.

Switchgear, Fuses and Fittings: Sharp [Stop switches for textile machinery] 4,896/15; Joel [Conduit joints] 5,240/15; Curtis, Mackley, and Igranic Electric Co. [Motor starters] 6,895/15.

Telephony and Telegraphy: Siemens & Halske A.G. [Telephone circuits] 27,646/13; Smith [Telephone systems] 4,582/15; Von Post [Means of establishing positive electrical connection between an aeroplane and its base] 4,573/15; Rivers-Moore [Oscillating systems] 4,862/15; Smith [Sound magnifying appliance for telephonic and telegraphic purposes] 4,953/15.

Miscellaneous: Möller [Electrical separation of suspended bodies from gases] 17,175/14; Grob [Electro-magnets] 24,537/14; Allies Electric Lamp Co., Le Naour [Machine for cutting lamp globes] 24,841/14; Gottschalk [Apparatus for electrically detecting vibrations] 4,349/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Windings for electrical apparatus, &c.] 7,080 and 7,081/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Instruments, &c.: F. Proksche [Circuit tester] 4,006/16 (100,201).

Telephony: A. E. Lundell [Exchange systems] 3,758/16 (100,198).

Miscellaneous: Quarzlampen Ges. [Medical quartz reflector lamp] 4,351/16 (100,207).

Application for Extension

Application has been made for the extension of the following patent beyond its term of fourteen years:—

22,653/02. **Telegraphy.** F. G. Creed, W. A. Coulson, and Creed, Bille & Co., Ltd. An instrument for printing in ordinary type messages received by another instrument in the form of perforated strip. (Objections must be lodged before May 23rd.)

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

9,488/02. **Strip Lighting.** A. W. Beuttell. A system of lighting by tubular lamps, with straight filaments placed in line end to end in single spring contact plunger holders in a trough-shaped reflector.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps, &c.: J. A. Rey [Gilt searchlight mirrors] 29,074/04.

Electrometallurgy and Electrochemistry: C. P. E. Schneider [Electric furnaces] 28,805/03.

Incandescent Lamps: W. P. Thompson (*Deutsche Gas Glühlicht Ges.*) [Mounting of metal filaments] 28,467/04.

Telephony and Telegraphy: T. C. Martin [Automatic telephone exchange systems] 30,458/09; C. Cordes [Condenser for telephone circuits] 30,548/09.

Miscellaneous: T. Mann and C. Gochel [Primary batteries] 28,820/02.

ELECTRIC POWER IN SLATE QUARRIES

A PAPER on this subject by Mr. G. K. Paton, containing a description of the electrical equipment of the slate quarries of North Wales, was read on April 12th before the Liverpool Engineering Society.

The transmission lines of the North Wales Electric Power Co. from its water-power station at Cwn Dyli, near Peny-gwryd, in the Gwynant Valley, now extend to the principal quarrying districts in an area of nearly 400 square miles. Power is transmitted at 10,000 volts to sub-stations at the quarries and distributed at about 500 volts. The neutral of the E.H.T. system is earthed at the power station, and the L.-T. systems are also earthed, care being taken to run the earth wire well away from the slate débris, which is of poor conductivity. Armoured bitumen cables and overhead lines are used, and it is worthy of note that, as regards cables, slate mines and quarries come under the Metalliferous Mines and Quarries Act, but no regulations are published relating to overhead lines in quarries, which therefore have to be constructed to conform with the Board of Trade requirements. Extensive guarding precautions are necessary, and a system of double insulators and anchor wires.

The principal slate-quarrying districts in North Wales are Blaenau Festiniog, Nantlle, Bethesda and Llanberis. In Blaenau Festiniog the workings are underground, and the slate and débris require to be hauled to the surface, electric power being used in the larger quarries, such as Oakeley, Maenofferen, and Llechwedd. Power is required in operating inclines, slate saw sheds, air compressors for rock drills, ventilating, and also for pumping. In the Nantlle district the quarries are of the open-pit type. Hoisting in these quarries is done by aerial suspension cableways and inclined hoists. At Bethesda and Llanberis the quarries are worked on the face of the hill and in pits, and the inclines are operated by gravity. Power is required for the slate saw sheds; in the Penrhyn quarries at Bethesda entirely new machinery has been laid down—saw tables, cableways, rope-way inclines, and air compressors—by which, it is expected that operating and production costs will be greatly reduced.

The paper proceeds to deal with these applications in some detail. One of the advantages of electric power for the slate-sawing machinery is that the saw tables need not be concentrated in large sheds, but may be arranged in groups of 12 to 15 tables, each group with its own motor. The saws are some 2 ft. in diameter, running at 26 to 36 r.p.m. with a feed of from 1½ to 6 in. per min., consequently a very slow-running main shafting is required. The following alternative methods of drive are used:—Worm gear coupled direct to line shaft, single reduction gear with belt drive from secondary shaft, or belt drive from slow-speed motor. The worm drive has advantages of compactness, and is very satisfactory in operation, but the gear and belt drive is useful in changing over an existing shed. Slate dust causes considerable wear on paper or hide pinions, and a helical-cut gear is preferable. A simple belt drive is only possible by using a slow-speed motor, such as of the "Cascade" type, but the power factor and efficiency are lower than for higher speed machines. Squirrel-cage motors with star-delta starter are mostly used, and the type of drive depends on local conditions. Other electrically driven machinery in the saw sheds includes slate dressing and saw sharpening, punching and setting machines. It is found that the cost of power at 1d. per unit works out at 5d. to 7d. per ton of output. The running load factor varies from 45 to 55 per cent. over 9½ working hours per day. It has not been found worth while to instal electric light in the saw sheds, as the quarry-men only work during daylight hours.

As already stated, several types of electric haulage are in use in the different quarry districts. In the Blaenau Festiniog district slate and débris from the mines are hauled from the lower workings to the shed levels by wagons on inclines worked by electrically driven haulage drums. In the Nantlle district, where the quarries are of the open-pit type, the slate blocks and débris require to be lifted out of the pit, and aerial suspension cableways and inclined ropeway hoists are used. The single ropeway hoists are driven by 70 B.H.P. motors and the double hoists by 150 B.H.P. motors of the slip-ring type, and an over-all efficiency of about 75 per cent. with unbalanced load and 85 per cent. with the wagon balanced is obtained, and the load factor in actual work varies from 12 to 15 per cent. The aerial suspension cableways, also driven by 70 B.H.P. motors, perform the following series of operations:—Empty wagon is lifted from landing stage to the necessary height. Empty wagon is run out to lowering point anywhere along the span of the main cable. Empty wagon is lowered by its own weight. Empty wagon is unhooked; full wagon or block is lifted to necessary height for landing at stage. The load is pulled along the main rope to landing stage. Load is lowered by its own weight. The series of operations takes about four minutes, and hooking and unhooking the wagons increase the time of a complete cycle of operations to six minutes, equal to 10 journeys per hour, as a maximum. In a ten-hour working day this gives at most 100 journeys, or about 200 tons per diem. At this rate the consumption of power at an average of 0·8 unit per ton would be 160 units. The average load requires a maximum power of 60 kw. or 70 B.H.P., which gives an average of 2·28 units per h.p. per diem. Over a longer period the average would amount to only about 50 units per diem, equal to only 0·715 unit per h.p. per diem. This is equivalent to a load factor of, say, 9 per cent. to a possible maximum of 28 per cent. over a ten-hour day, and under normal working conditions 10 to 15 per cent. would be a fair average.

The rock drilling is usually carried out by compressed air drills supplied from centrally situated electrically driven air compressors. In a typical example the motor is of 150 h.p. The paper concludes with a summary of the advantages of bulk supply for a power load of this nature.

SMALL POWER MOTORS

THERE is at the present time a large and increasing demand for small power motors which are efficient and reliable in operation, and at the same time moderately low in price. We are able to give illustrations of two such

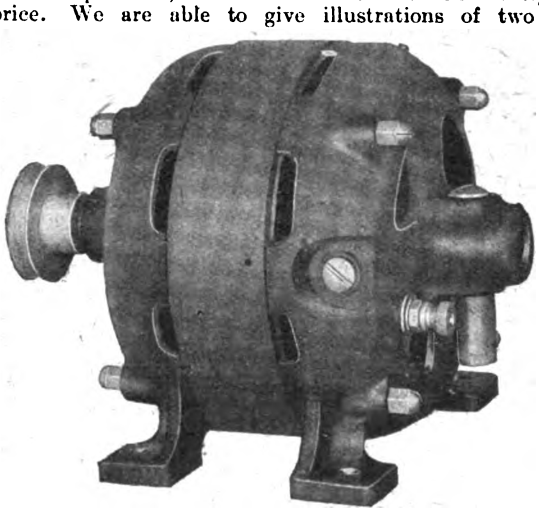

FIG. 1.—B.T.-H. CONTINUOUS-CURRENT MOTOR, ⅛ H.P., 110 VOLTS.

motors, which are examples from a new line developed by the British Thomson-Houston Co., Ltd. (Rugby). It will be observed that these, though of only ⅛ h.p. and ½ h.p. respectively, are built with a general outline similar to that of larger machines, which makes them very attractive in

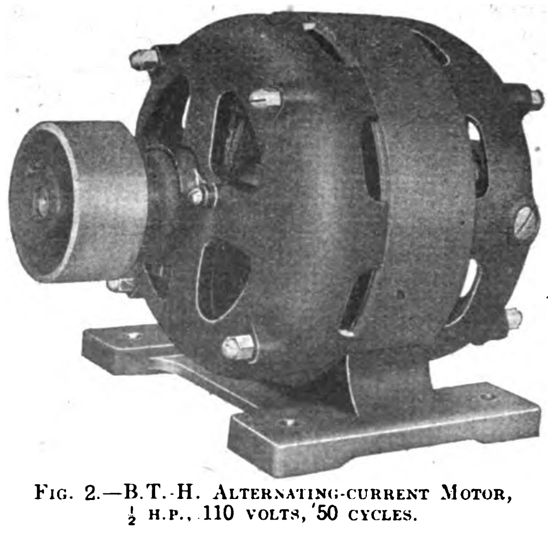

FIG. 2.—B.T.-H. ALTERNATING-CURRENT MOTOR, ½ H.P., 110 VOLTS, 50 CYCLES.

appearance and doubtless robust in construction. These motors, both A.C. and D.C., are standardised for ratings of 1/200 to ½ h.p., at 110 and 220 volts, the A.C. motors for circuits of 50-cycle frequency. The continuous-current motors, rated at more than 1/10 h.p., are compound wound,

thus having a higher starting torque than shunt-wound motors, while the speed regulation is sufficiently constant to satisfy all ordinary conditions of service. The alternating current motors, one of which is illustrated in Fig. 2, are of the split-phase induction type, the primary winding being placed on the rotor and the secondary on the stator. These motors are rated for continuous service with a temperature rise not exceeding 40° C.

LOCAL NOTES

Brighton: *The North Road Works.*—It is stated that the whole of the generating machinery at the old North Road generating station has been disposed of. The engines and boilers fetched £4,700, the original cost being £14,000. This station, of course, became unnecessary for generating purposes when the Southwick power-house was decided upon.

Dundee: *Wiremen's Wages.*—We referred on p. 127 of our issue for April 6th to the fact that an application for an increase in wages by the local wiremen had been referred to arbitration. The arbitrator, Sheriff J. L. Laing, of Aberdeen, has now issued his award. The men asked for an increase of 2d. per hour on their present rate, making 11d. per hour, but the award gives them ½d. per hour.

Rhyl: *A Diesel Engine Problem.*—The Electricity Committee has been authorised to spend £200 in carrying out alterations of their Diesel engines to enable them to use tar-oil fuel instead of crude oil. The recent discussion by the members of the Diesel Engine Users' Association is interesting in this connection (ELECTRICAL ENGINEERING, Feb. 17th, p. 56, and April 13th, p. 132).

Stoke-on-Trent: *Contract Arc Lighting.*—Arrangements have been made by the Corporation and those consumers who have contracts for outside arc lighting that no charge will be made for this during the period of lighting restrictions on the understanding that the contracts are renewed when the present restrictions are removed.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Accrington.—Communications have been received from the Local Government Board and the Minister of Munitions sanctioning the scheme for extending the generating plant at an estimated cost of £14,000. The work is to be proceeded with at once.

Bedford.—High-tension mains are to be carried to a number of premises, these extensions involving the installation of transformers.

Burton-on-Trent.—Mains extensions are to be carried out at an estimated cost of £600. Transformers will also be required.

London: *Bermondsey.*—In connection with an application by the Council for a loan of £3,000, made up of mains £1,000, house services £1,500, and meters £500, the Finance Committee of the L.C.C. call attention to the fact that £1,162 of the total is in respect of future applications for current, the remainder being already incurred in giving supply to firms engaged on Government work. As regards the £1,162, the Borough Council points out that for a considerable time no extensions to premises not engaged on Government work have been made unless the consumer agreed to pay the full cost of the service, and that it is intended to continue to follow this plan. The Finance Committee of the L.C.C. suggest that a round sum of £1,000 for mains, services, and meters should be sanctioned, provided all new connections are limited to consumers doing work for the War Office or Admiralty.

Stepney.—A loan of £3,000 is recommended by the L.C.C. towards the cost of providing two new boilers. The actual cost is £19,000, but the Borough Council has £16,000 in hand. Treasury approval has been obtained.

Woolwich.—The Finance Committee of the L.C.C. recommend sanction to a loan of £27,500, repayable as to £27,115 for plant within 15 years, and as to £353 for mains within 25 years. The Treasury have approved of this borrowing.

Londonderry.—An expenditure of £8,000 is contemplated upon the electrical undertaking.

New Zealand.—The Oamura Council require overhead mains and street-lighting equipment, meters, transformers, and accessories. Further particulars at 73 Basinghall Street, E.C., and tenders by June 23rd. This information is only of use to firms who can cable agents.

Stoke-on-Trent.—The Borough Electrical Engineer has received instructions to report as to extensions at the power-house.

Warrington.—Boiler plant and economiser for Electricity and Tramways Committee, Borough Electrical Engineer, April 26th.

Wigan.—High-tension 3-core, paper and lead covered, armoured feeder cable; transformer and switchgear. Borough Electrical Engineer, April 26th. (See an advertisement on another page.)

Wolverhampton.—A report recommending extensions at the electricity works at a cost of £17,160 has been sanctioned by the Corporation. The scheme is necessary in order to deal with the winter load of 1917.

Miscellaneous

South Africa.—The South African Tender Board require two 50-ton electric overhead travelling cranes at the Salt River workshops. Tenders will be received up to May 15th by the High Commissioner for the Union of South Africa, 32 Victoria Street, S.W., from whom further particulars can be obtained.

APPOINTMENTS AND PERSONAL NOTES

The Worksop Council have decided to grant leave of absence to their electrical engineer, Mr. J. P. Crowther, who has joined the Electrical Engineers Corps (Royal Engineers), and to pay him half salary during his service with the colours. His work will be taken over by the station superintendent, Mr. J. Fletcher, who will receive an increase of salary of £25 per annum. There is considerable local opposition, however, to Mr. Crowther receiving half salary and for such a small increase to be made to the salary of the employee who will carry out his duties. It has even been suggested that a town's meeting shall be held to discuss the matter.

The salary of the new manager of the Belfast tramway system, applications for which post in succession to Mr. Andrew Nance are now under consideration, is fixed at £800 per annum.

The North Metropolitan Electric Power Supply Co. want a Junior Charge Engineer at their St. Albans electricity works. (See an advertisement on another page.)

A working electrical engineer and fitter is required at the workhouse, Axbridge, Somerset. Commencing salary £88 per annum. Candidates must be married and ineligible for military service. Applications to Clerk by April 25th.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

South Wales Electrical Power Distribution Co.—The report for 1915 shows a material increase in output during the year, the units sold amounting to 28,967,656, against 26,510,198 in 1914. As under the working arrangement with the Treforest Electrical Consumers Co. the whole of the working expenses of the South Wales Co. are borne by that Company, no revenue account is submitted. Sanction was obtained during the year to the issue of £80,000 5 per cent. prior lien debenture stock, and this has been duly placed.

W. T. Glover & Co.—At the annual meeting last week the report and accounts referred to on page 110 of our issue for March 23rd were adopted. Mr. A. L. Ormrod, the chairman, said that the financial position would have enabled a higher dividend to be paid on the ordinary shares, but money was wanted in the business, and would return value in due course. As a matter of fact, after deducting the interest on the first and second debenture stock and the amount to be paid on the preference capital, the Company had earned nearly 37 per cent. on the ordinary capital.

Price of Copper.—Messrs. George Smith and Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £137 to £139 (last week £134 to £136).

ELECTRICAL ENGINEERING.

The Engineering Journal of the Electrical Industry

With which is Incorporated

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The Government has decided that strict economy in paper is necessary, and, in consequence, to prevent waste, the majority of newsagents and bookstalls will limit their stocks so far as possible to the actual known requirements of their customers. A mere verbal order will, however, be sufficient to ensure that a copy is sent or reserved weekly.

"Electrical Engineering" can also be sent direct to readers by post. Copies are posted on Wednesday evening, and should reach readers in practically every part of the United Kingdom on Thursday (in London, and many other towns, by first post). Orders, with a remittance of 6s. 6d. for one year, 3s. 3d. for six months, or 1s. 8d. for three months, which includes postage (Colonies and Abroad 8s. 8d. per annum), should be sent to the Kilowatt Publishing Co., Ltd., 203, Temple Chambers, London, E.C.

SUMMARY

THE Government of Saxony is taking over the whole of the electricity supply in that country. We give details of the scheme, which presents features of considerable interest (p. 148).

AT the April meeting of the Diesel Engine Users' Association the discussion was continued on the recent accident to an air-compressor at Smithfield Markets, due to the bursting of a purge pot. Reference was made to a similar accident which occurred three years ago at the Hoffman Mfg. Co.'s works (p. 148).

MR. E. T. WILLIAMS' Institution Paper on "The Electricity Supply of Great Britain" was discussed at Manchester on April 18th, when Mr. J. A. Robertson suggested an alternative scheme for dealing with the problem. He advocated the grouping of undertakings in certain districts, and the formation of a Joint Electricity Board for each district, which would gradually acquire administrative powers; the cost of linking up would be borne temporarily by local authorities (p. 149).

AN article from a French contemporary reviews the effect of the war on the electric supply industry in France. After a temporary check a great increase in power demand is proceeding, in the meeting of which water-power is taking an important place (p. 150).

A NUMBER of books are reviewed on p. 149.

OUR Questions and Answers page this week deals with the best method of ascertaining whether the series winding of a generator is opposed to the shunt winding (p. 151).

AMONG the subjects of specifications published at the Patent Office last Thursday were communication with aeroplanes, telephony and transformers. A patent for heating elements has been granted in spite of opposition. Patents relating to electrolysis and wireless telegraphy expire this week after a full life of 14 years (p. 152).

THE tramway strike at Croydon continues.—The Manchester Tramways Committee is only able to make the usual contribution to relief of rates by drawing on the reserve fund.—There was a loss of £64,000 on the London County Council Tramways last year (p. 152).

A GENERAL descriptive Paper on A.C. motors was read before the Association of Supervising Electricians by Mr. H. C. E. Jacoby on April 4th. The author chiefly dealt with the adaptability of various types of motor to speed control (p. 153).

SEVERAL more electricity undertakings have been compelled to increase their charges (p. 154).

METERS, motors and starters, and transformers are required in Australia (p. 154).

ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEERS CORPS

COMPANY ORDERS BY LIEUT.-COL. C. B. CLAY, V.D.
Drills, 6.25 to 7.25: 7.25 to 8.25 p.m.

(To-day) Thurs., Apr. 27th: Shooting for Sections 3 & 4. Recruits, 5.45 to 7.45 p.m.

Fri., Apr. 28th: Sections 3 & 4, technical; Sections 1 & 2, squad and platoon. Signalling Class and Recruits.

Sat., Apr. 29th: Adjutant's Instruction Class at 2.30 p.m.

Sections for technical parade at Headquarters, London Electrical Engineers, 45 Regency Street, S.W.
Sections for shooting parade at miniature ranges.
Unless otherwise ordered, all parades at Chester House.

The Electrical Industry after the War.—The President of the Board of Trade has appointed the following Committee to consider the position of the British electrical industry after the war, with special reference to international competition, and to report what steps, if any, are necessary or desirable in order to safeguard that position:—Hon. Sir Charles Sarson (chairman), Mr. J. Annan Bryce, M.P., Mr. T. O. Callender, Mr. James Devonshire, Mr. B. M. Drake, and Sir John Snell. All communications should be addressed to the Secretary, Electrical Trades Committee, 7 Whitehall Gardens, S.W.

Coupled Motor Tramcars.—A device adopted by Newcastle Corporation for relieving congestion on the tram routes and for overcoming the difficulties due to shortage of drivers and conductors is described in *The Tramway and Railway World*. It consists of the use of coupled motor cars, after taking away one motor from the inside axle of each car. The trolley standard on one car is removed. The controllers on the centre platforms have also been removed, leaving a controller at each end of the unit only. Another change is a complete re-wiring of the cars on the power circuit. One motorman controls the two cars, and each car has a woman conductor. The route operated over is fairly flat, the maximum gradient being about 1 in 20. The coupling consists of a rigid bar spring connected to each car platform, and the power cables pass through tubes fixed on the top and bottom of this coupling bar. To protect passengers the cars are equipped with side guards, consisting of telescopic rods and tubes, and the device works remarkably well, even on curves of 40-ft. radius. When running after dusk there are lights just under the brake handle in the centre, which are fitted with ruby lamps, to draw the attention of passengers to the fact that there is a car immediately following. This plan has been found to act very well in practice. While the coupled cars are a little slower than a single car with the same equipment, it is found that the double units can easily keep up to the schedule time of the many heavy bogie cars with four motor equipment that are running on the same route, while the combination units have the advantage of consuming less energy.

STATE CONTROL OF ELECTRICITY SUPPLY IN SAXONY

We referred some weeks ago to the decision of the Government of Saxony to take over complete control of the generation and distribution of electricity in the State, and to the acquisition of certain coalfields, with the idea of generation on a large scale at two or more central stations.

The Government has already purchased, for the sum of £250,000, the steam generating station at Hirschfelde (on the River Neisse, east of the railway line Zittau—Gorlitz), of the Elektricitäts-Lieferungs-Gesellschaft of Berlin. This station has a capacity of 25,500 kw., and the plant is quite new. The works are close to one of the coalfields acquired by the State, and it is the intention shortly to enlarge them considerably. At present the coal for these works is obtained under contract from another colliery, which asks too high a price to be bought up.

The supply industry of Saxony comprises at present a collection of independent stations without any attempt at standardisation or co-operation. Four or five years ago an Association was formed by some of the municipalities under the name of the "Association of the Saxon Municipal Electricity Works," with the object of protecting the interests of these municipal works against the monopolist tendencies of the large supply undertakings, and to encourage State control. In May, 1914, this Association put before the Government a constructive programme, the basis of which was to erect two large central stations in the east and west respectively, from which power would be distributed and sold in bulk to all the works of the local authorities included in the Association. The Government then, however, did not see their way to grant the necessary permission for the carrying out of this scheme.

Shortly afterwards, the Association was considerably strengthened by the inclusion of further municipal works, and proposed further to buy up a number of private undertakings. The Government then stepped in and took over the scheme, which will eventually embrace the electrification of the interurban, local, and suburban railway lines, and possibly, at a far-distant date, long after the close of the war, the main lines also. The Government states that there is no intention of using the proposed scheme as a means of bringing in revenue, but that the main object is to ensure a supply of cheap electrical energy all over the kingdom.

Further to the extension of the recently-purchased station at Hirschfelde, the Government will erect a new works near the western coalfields between Breitingen and Regis, but this will not be for some time, as there are already several modern generating plants in the district. Negotiations are now going on between the Government and these undertakings to arrange the necessary co-operation and their future relations. Negotiations are also going on for the acquisition of all the existing extra high- and high-tension transmission lines and the development of a comprehensive transmission network which has been designed by the State engineers on the lines laid out by the original municipal Association. New transmission lines are to be constructed at once, to link up the existing generating stations and enable them to co-operate and deal with the whole demand until the large State generating stations are completed. As all the large stations in the western area have three-phase plant of the same frequency, it will be necessary only to instal transformers at various points to deal with the different transmission voltages. Private undertakings will eventually be bought up by the State, and the generating stations, if modern enough, worked in parallel with the new State stations.

The Government has declared itself ready to enter into contracts with any local authorities for bulk supply, whether there are transmission lines in the neighbourhood or not.

The Government declares that it has no intention of preventing individuals or individual industrial concerns from generating power for their own consumption, just as they will not interfere with the rights of local authorities to continue generating for the requirements of their community. On the other hand, if the State scheme is to be a success, it is absolutely necessary that all private undertakings should be taken over in the shortest possible time, and not only their generating stations, but also their distributing networks. Arrangements will therefore be made with all private undertakings to provide for the purchase of the complete undertaking within ten or fifteen years. The question as to how the retail sale of current to the consumers of such undertakings will be dealt with will be settled in each case when the time comes.

A new Government department, to be called the "Direction of the State Electricity Works," will be formed to manage the scheme. This will comprise the technical adviser of the Ministry of Finance as Director, and two other engineers, one of whom will be chosen from the State service and the other from one of the large existing private undertakings of Saxony. These two latter engineers will have control of the eastern and western areas respectively. Further, a Council under the name of the "Landselektricitätsrat," will be formed, composed of representatives of the various local authorities, associations, and private undertakings taking a supply from, or in any other way connected with, the scheme.

The cost of the whole scheme, including opening up the State coalfields (said to be surface deposits) and the construction of the new power stations and transmission lines, is estimated at approximately £1,000,000.

There is considerable opposition in Saxony to the proposal. The Association of the Saxon Municipal Electricity Works, the "Elektroverband," has presented a petition against the scheme in both Chambers, emphasising that any such centralisation of electricity supply should be in the hands of a public corporation in which the municipalities, private companies, and the State should be jointly interested, and not alone in the hands of the State. The proposals were brought up in the Second Chamber on April 4th, and are still under discussion.

DIESEL ENGINE USERS' ASSOCIATION

Air Compressor Accidents

At the April meeting of the Diesel Engine Users' Association a further discussion took place on the accident to an air compressor attached to a Diesel engine at the Smithfield Markets Electric Supply Co., Ltd. (see Electrical Engineering, April 13th, p. 132). Mr. P. H. Smith, of Messrs. Banks, Warner & Co., Ltd., who had reported on the breakdown to Lloyd's Underwriters, with whom the engine was insured, was present at the meeting, and he gave some further information on certain points which arose in connection with his report.

Mr. R. Lyle referred to an accident of a similar nature which had occurred on an air compressor attached to a 300-b.h.p. Diesel engine at the works of Messrs. Hoffman Manufacturing Co., Ltd., in 1913. On this occasion, fortunately, no personal injuries resulted from the accident. The engine had been at work continuously for twenty-four hours before the accident occurred, whereas in the Smithfield case the accident occurred on starting up the engine. It was found that the H.P. suction and delivery valves of the compressor were somewhat worn and fouled with the carbon deposit. An exhaustive inquiry was held, but no very definite conclusion was arrived at. Two theories were advanced to account for it. In the first place, it was suggested that the bursting of the purge pot was caused either by the high pressure getting back from the blast vessel or being built up, or, secondly, by high pressure due to combustion or explosion of oil vapour. Mr. Lyle did not think that the first theory was tenable, as the calculated bursting pressure in the blast vessel did not exceed 850 lb. at the time of the accident; the bursting pressure could not either be built up, as a test by the makers, which consisted in blanking off the delivery pipe and running the compressor up to full speed, proved that the relief valves dealt efficiently with the air. He considered the trouble was undoubtedly caused by explosion.

There was, however, another possible cause of the accident which his experience suggested. He had been able to satisfy himself that one cause of a rise in temperature in the I.P. purge pot is from the choking of the I.P. cooling coil, due to a carbon deposit taking place at the sharp gunmetal bend which couples the I.P. delivery pipe to the cylinder. This might lead to the generation of an ignition pressure and temperature at this particular spot, and this pressure would not be recorded by a gauge on the I.P. purge pot.

The precautionary measures taken as a result of the accident were as follows:—A check valve was fitted on the H.P. delivery pipe as close as possible to the air compressor casing; pressure gauges were fitted to the I.P. and L.P. stages so as to give timely warning when the valves needed attention; instructions were given for the valves to be cleaned at more frequent intervals, and it was recommended that this should be done every six weeks, but experience gained by a study of the gauge pressures would be the best guide; the valves also should be renewed before any play or rounded seatings became accentuated.

Referring to Mr. P. H. Smith's recommendations in connection with the Smithfield accident, Mr. Lyle stated that his experience led him to suggest that the provision of anti-vibrators in connection with the gauges was better than throttle valves as being more reliable in damping the oscillations and in providing freedom from choking. He considered that large relief valves provided no proper safeguard against explosions, though he quite agreed that valve wings choked the area. He thought that a non-return valve should certainly be fitted between the H.P. delivery and the blast bottle.

The next meeting of the Association will be held on Wednesday, May 10th.

THE ELECTRICITY SUPPLY OF GREAT BRITAIN

Mr. E. T. Williams' Institution Paper on electricity supply, read in London on April 13th, and reported in our last week's issue, formed the basis of a discussion at a meeting of the Manchester Section of the Institution on Tuesday, April 18th. This discussion was opened by Mr. J. A. Robertson (Salford), who directed his remarks to a consideration of "The present position of electricity supply in the United Kingdom and the steps to be taken to improve and strengthen it." He said that all central station engineers would agree that centralisation is desirable, but there are certain stages of development to be passed and difficulties to be overcome which are overlooked in Mr. Williams' Paper. The technical difficulties cannot be set aside, particularly the differences in periodicities in various districts. He thought that to place the control of a district comprising, say, the Midlands or the north-west of England in the hands of one engineer manager would not commend itself either to engineers or local authorities. The scheme did not propose to interfere with existing undertakings, but simply to set up a trading concern selling electricity in bulk. The power companies have been trying to do this for years, and have made little headway because they found in most cases that bulk supply cannot be given to central stations at a price which will pay the standing charges on the necessary cables, converting and transforming plant, and also the standing charges on the superseded generating plant. Again, the Central Board would have no powers to compel a local authority to shut down its generating station or to fix the price which the existing authorities are to charge for current. A local authority might therefore continue to operate its own plant, and even to pay for its extensions out of revenue, or it could purchase current from the State system in bulk and resell it at prices which were deliberately fixed high to ensure large profits for the benefit of the district rates. In either case the object of a bulk supply scheme, *i.e.*, the provision of cheaper electricity for all industrial and domestic purposes, would be defeated.

Mr. Robertson did not consider the present to be an opportune time for central station engineers to discuss questions of this magnitude. State ownership may be the solution of the all-electric problem, but we will be faced with an enormous difficulty probably in a few months, or at most in a year or two, to meet the demand for a cheap power supply which is vitally essential for increasing the productive capacity of our manufacturers after the war. Our task for the present is to ascertain what steps can be taken to utilise our *existing* facilities to the fullest extent, taking care only to make extensions or adopt methods which could be worked in as part of a larger scheme when the time is ripe for it. The policy of linking up existing undertakings, which has been adopted in one or two London boroughs, ought, he thought, to be seriously considered. As an instance of what linking up might do, the Manchester district is a striking example. There are situated within the Manchester area fifteen generating stations with an aggregate generating capacity of 170,000 kilowatts. Nine of these stations are generating three-phase energy at 50 periods, and there are no technical difficulties to prevent them being linked up immediately. The result would be an enormous benefit all round. In place of each station requiring to maintain a complete equipment of reserve plant, the stations would act as reserve to each other, and the aggregate demand on the whole of the stations could be increased by 30 to 40 per cent. with perfect safety. The risk of interruption would be greatly diminished, and by running the most efficient plant on the system continuously at full load, leaving the less efficient plant for peak loads, the cost of operation would be greatly reduced. A number of stations could be shut down entirely at week-ends. The smaller generating stations with D.C. plant would gradually install transforming and converting plant and so receive the benefit of the combination.

The formation of joint Boards for each district was proposed, consisting of representatives elected by the supply authorities along with a certain number of independent members appointed from the local manufacturers, who are, after all, the parties most interested in the question of cheap power supply. The cost of linking up might be borne by the local authorities in proportions which could be determined either by the use made of the bulk supply, *i.e.*, the standing charges on the capital cost could be allocated in terms of the electrical energy purchased in bulk, or, considering the general all-round advantage of such a scheme, there would be no serious injustice if the cost was borne in equal proportions by each of the undertakings.

Referring to the question of fuel supply, Mr. Robertson said that coal getting and coal distribution are an outstanding example of our haphazard methods in dealing with matters of vital importance. The colliery owner is left free to extract the coal, to sell it to the highest bidder, even though he be the agent of a foreign Government not too friendly to this country. There is no attempt to grade or classify coal from particular districts for industrial purposes. Prices vary within wide limits, and at one time we are threatened with interruption of supplies through workmen's strikes, while at another stocks are held up in order to artificially inflate prices. He would suggest that the time had arrived when a Commission should be appointed by the Government to report on our national supply of fuel with the object of utilising it to the best advantage for the various chemical, metallurgical, and other purposes for which it is required.

The question of transport should also be dealt with, so that we should not witness the anomaly of coals being shipped from Newcastle to Manchester district, whilst collieries within a 20 mile radius of Manchester are actually sending consignments of coal to Newcastle for export. The Limitation of Prices Act will require to be strengthened and compulsory arbitration introduced to prevent an interruption of coal supplies through strikes of workmen. To avoid such strikes, some form of profit-sharing might be established which would give the worker a direct interest in the concern for which he works.

In the course of speeches by other members, it was remarked that a continuance of high coal prices after the war might be all the better for the public supply of electricity; that the question of finance under Mr. Robertson's scheme would need to be considered; that large units of plant for electricity supply were more than justified; that the linking up of stations would be economical, as had already been shown in certain London boroughs; that there was a limit beyond which it was undesirable to have super-stations; and that in certain areas, such as Manchester, the standardisation of prices was requisite.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Questions and Solutions in Telegraphy and Telephony Final Examinations. Compiled by H. P. Few. 74 pp. 7¼ in. by 5 in. 21 figures. (London: S. Rentell and Co., Ltd.) 1s. 6d. net; by post, 1s. 7½d.

This is a good little book, and many a telegraph and telephone engineer, let alone the student, will find something to learn in it. Here and there, however, the Author has been less careful than he should be in a book of this character. For instance, the printers have been permitted in one place to print "capacitor" for capacity, and in the same answer the Author uses *d* both for the surface density of the charge and the diameter of the conductor, and, moreover, the answer involves the use of a simple integration, thus giving *d* a third meaning.

"The Practical Engineer." Electrical Pocket-Book and Diary for 1916. 646 pp. 5¾ in. by 3½ in. 159 figures. (London: The Technical Publishing Co., Ltd.) Cloth, 1s. net.; by post, 1s. 4d. Peltine, 1s. 6d.; by post, 1s. 10d.

Although a considerable range is already covered by this conveniently arranged pocket-book, new sections dealing with telephones and first aid are included this year. A special feature of this book is the section on laws and official rules relating to electrical engineering matters, and at the end of each section there is a short list of books dealing with the part of the subject in question. The information throughout is practical and concise.

An Introductory Course of Continuous-Current Engineering. By A. Hay. 360 pp. 8¾ in. by 5½ in. 199 figures. (London: Constable & Co., Ltd.) Second edition. 6s. 6d. net; abroad, 7s. 2d.

The second edition of this well-known work by Dr. Hay has now been revised and reprinted. Most of our readers are probably familiar with the book; it approaches the subject from an engineering rather than a scientific standpoint, though, needless to say, it is scientifically accurate in its treatment. We can cordially recommend it to students and engineers as a most useful supplementary text-book on the subject.

The Universe and the Atom. By M. Erwin. 314 pp. 8¼ in. by 5½ in. 58 figures. (London: Constable & Co., Ltd.) 8s. 6d. net; abroad, 9s. 2d.

To those to whom the subject of the structure of the Universe and the ultimate nature of matter and electricity makes

any appeal at all, we can confidently recommend this book. Such knowledge as we have on this subject has been chiefly the property of the mathematician, who has not always been able to give his knowledge a mechanical interpretation. The author of this book, however, succeeds to a great extent in making the subject intelligible to the lay reader. A simple theory of electricity on mechanical principles is given, according to which electrons are created by "setting standard ether particles in revolution."

EFFECT OF THE WAR ON ELECTRICITY SUPPLY IN FRANCE

Our French contemporary, *La Lumière Electrique*, publishes an interesting article on the business of the electric-power distribution undertakings throughout our Ally's country as affected by the war. The declaration of war in August, 1914, produced, of course, an immediate drop in the receipts of all such concerns, and this adverse effect reached its maximum at the end of that year. Matters, however, began to improve in the early months of 1915, as the newly created "war industries" began to develop and new munition works sprang up all over the country, and especially as the output of shells became greater every day. The effect of this was that the extra demand for power was very strongly felt in the second half of 1915, and the necessity, owing to questions of freight, &c., of producing as much raw material as possible in the country itself, particularly nitro-compounds and other chemical products and also aluminium, was a powerful factor.

Water-power stations were largely called upon; many soon became loaded to their maximum capacity and some extended their plant, partly with the assistance of State aid that was forthcoming. The steam-driven stations were placed in a more difficult situation on account of the serious increase in the cost of coal, which in some cases was quintupled in price. Transport considerations increased the difficulties of fuel supply, and extensions of steam stations were only practicable to a limited extent owing to increases in cost of 100 to 200 per cent. of new boilers and 100 per cent. of steam turbines. The majority of the steam undertakings were obliged to insert in their contracts for power supply a clause providing for increasing rates according to the variation of coal cost. This was, however, not the case with the lighting load. Another effect of the loading up of the generating stations was the shutting down of some of the older stations constructed from fifteen to twenty years ago and their replacement by large modern power houses.

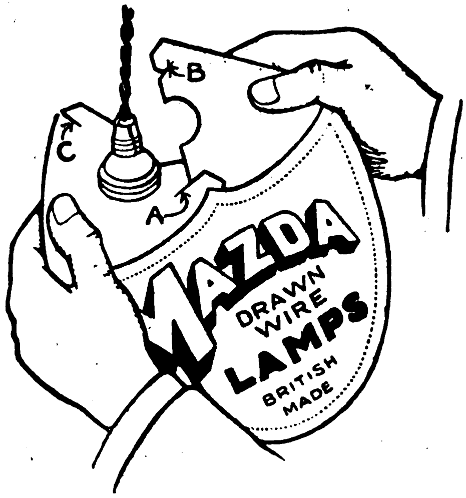
In general the present situation is a rapidly growing demand for energy for power purposes, but a less marked increase in the lighting load. The distributing systems fed entirely from water-power stations are experiencing increasing receipts and increasing profits. On the other hand, those depending on steam plant are far from being able to produce an increased profit from their increased turnover owing to the great rise in costs. The total results during 1914 and 1915 are not so widely different as the business during the first seven months of 1914 was good, and that during the last five months bad, while in 1915 the results of the first half-year were "moderate," and of the second half-year "fairly good." Compared, however, with the second half of 1914, the corresponding portion of 1915 shows in general a marked increase in receipts. This is particularly so in the case of such a company as the Société Hydro-Electrique des Basses Pyrenées, in which the increase is 80 per cent. Other companies are reported to have experienced increases of 9 to 17 per cent., but in cases in the more agricultural districts the increase is less owing to their having suffered less in 1914. The case of Paris is interesting. The total consumption of current during the last five months of 1914 had fallen to 20 million kw-hours, as compared with 38 million for the corresponding portion of 1913, but for that period in 1915 had risen again to 34 million. It is difficult to arrive at figures for the more northerly districts owing to the increase in the receipts being partly due to increased cost of coal, as already mentioned, and to the very varying effect of proximity to the line of battle.

The situation has continued to improve since the commencement of 1916, and the figures quoted in the article for a number of large-power companies show that, with the exception of some of the steam-driven stations, the set-back due to the war has not been really great, and that a very favourable outlook now presents itself. The great lesson taught has been the importance of water power plant and the necessity for developing the so-called *houille blanche*, or "white fuel," industry of France.

"MAZDA" SHADE FOR SUBDUED LIGHTING

The more stringent regulations lately enforced by the authorities as to the lessening of outward illumination from shops, offices, and private residences have made it necessary for increased precautions to be taken. It is no longer sufficient in private houses or offices to use light-coloured curtains or blinds, while in shops the source of light must be so shielded that no direct rays can pass outside. Something safer, more durable, and of better appearance than tinted paper around the lamps is called for in view of the prolonged period over which the restrictions seem likely to extend, and specially designed shades are needed. A neat and effective screen of attractive appearance is being issued by the British Thomson-Houston Company, Ltd., Mazda House, 77, Upper Thames Street, E.C., and any number in reason will be supplied to business firms, contractors, and retailers upon request.

The shade is posted flat and is made up of stout, dark-



coloured card, with stencil cut-out lettering backed by orange-tinted paper. From the accompanying illustration it will be seen that the shade can be placed over any electric lamp without removing the latter, while if an ordinary fancy glass shade is used, the "Mazda" shade will go over it. To place the screen in position the two wings are locked together around the holder, this movement causing the shade itself to assume a curved form, thus shutting off the direct light rays from about one-third of the circumference of the lamp. With the lamp alight the shade has a striking effect, the lettering showing up with a warm tint by transmitted light, and while shutting off all direct light in front, permits of ample illumination behind. Unlike some temporary shades, its appearance by daylight is quite attractive, the wording being clearly outlined by reflected light. Such a shade, while costing nothing to the user, and having no adverse effect upon the life of the lamp, meets fully the police requirements and does not disfigure any shop or office in which it may be fixed.

Electric Light Switching Competition.—The results of Messrs. A. P. Lundberg and Co.'s electric light switching competition, published in our advertising pages, show that these competitions continue to attract much attention, notwithstanding the abnormal conditions in which we are living. It is not surprising, therefore, that Messrs. Lundberg are starting immediately a supplementary competition, full particulars of which may be had on application to them at 477-489, Liverpool-road, N.

The Mysore Electric Power Scheme.—According to *Indian Engineering*, Mr. S. G. Forbes, Chief Engineer at the Government Electricity Works, Mysore, has prepared schemes with a view to supplementing the amount of electrical energy available at the Cauvery Falls. He anticipates an additional 40,000 h.p., and possibly 50,000 h.p. One of the projects in mind is the electrification of the railway from Bangalore to Mysore, for which it is suggested an average consumption of 1,000 h.p. per day would be required.

War Tribunals.—The Sunderland Tribunal has granted conditional exemption to an electrician in private employ, it being established that the man is an expert with X-ray apparatus and is very often needed at the Sunderland Royal Infirmary and also by the military. The exemption, however, is only so long as the man remains in his present employ.

Electricity and Surgery.—At the Royal Institution on Friday, May 5th, Sir James M. Davidson, M.B., will deliver a discourse on "Electrical Methods in Surgical Advance."

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,492.

After repairing a joint box of a three-phase cable feeding overhead lines at 3,000 volts, the insulation of the three conductors (cable and line connected together) was 6 megohms, 10 megohms, and 12 megohms respectively. At the other end of the lines is a three-phase lighting transformer, the insulation of which, tested separately, was 20 megohms. On repeating the test with transformer across the line, an insulation resistance of 1·5 megohms was obtained. The testing instrument was a "megger" in all cases. What is the explanation?—T. G. E.

(Replies must be received not later than first post, Thursday, May 4th.)

ANSWERS TO QUESTION No. 1,490.

Which is the best way to ascertain if series winding on a 150-kw. 220 volts D.C. generator is opposed to shunt? The machine has interpoles, and runs in parallel with another (having no interpoles), so power is available for any test. The voltage on machine to be tested is 230 running light, but with 600 amps. load drops to 210; the rated voltage is 220; this drop occurs when machine is in parallel, and also when taking load alone, so brush position relative to generator running and resistance of equaliser connections need not be considered.—BOOSTER.

The first award (10s.) is made to "Alpha" for the following reply:—

The simplest method of checking whether the series winding is assisting or opposing the shunt is as follows:—Let the machine to be tested carry the whole load of the station, the other sets being shut down and the equaliser switches of course open. Note the voltage and load amperes (if the load is a fluctuating one, several simultaneous readings should be taken). Now, without changing the field rheostat, close the equaliser switch of the machine carrying the load and also of one or more of the idle generators in the station. This will divert some of the load current from the series field windings of the machine carrying the load. If the series winding is assisting the shunt winding, the voltage corresponding to a given load will drop when part of the current is diverted from the series field. Conversely, if the series is opposing the shunt, the voltage will rise when the series field is diverted.

It is probable that the series winding is either assisting or opposing the shunt winding as a whole, in which case the above test will give all the information required, but there is another possibility, *i.e.*, that the interconnections between the spools have been made in such a way that the series winding opposes the shunt in one or more of the spools and assists it in the remainder. This will usually show up by causing sparking on one or two brush studs, but the writer has known cases where the operation of the machine was quite good, although some of the field windings were reversed in this way. To check this, the load should be transferred to another generator and the suspected machine shut down. Open the equaliser switch and excite the shunt field from the busbars, taking care that the polarity of the field is the same as though the machine were running self-excited as usual. Now determine the polarity of each pole by means of a compass. This needs some care, as it is easy to get misleading results owing to the various leakage paths. The best way is to take a bundle of *soft* iron wire and hold one end against the pole shoe, bringing the compass up to the other end of the wires. Do not let the wires touch the armature core. The poles should, of course, be N. and S. alternately. Note which are N. and which are S., then open the shunt field circuit and close the equaliser switch so that some of the load current of the station may flow through the series winding of the machine. Again take polarity by means of the compass. If the series winding is assisting the shunt this should be the same as before for all the poles.

The second award (5s.) is given to "W. H." for the following reply:—

It will be observed that the two 150 kw. generators operate successfully in parallel and give substantially the same voltage variation as when running singly. This practically proves that both machines are similarly compounded, and from the figures given it would seem as though the series field turns were aiding the shunt, as, if the compounding were differential, one would expect a much greater drop in volts than 9 per cent. with a change in load from no load to 600 amps. On the other hand, there would appear to be something wrong with compound-wound generators in which the series aids the shunt, and where the voltage drop is as great as 9 per cent. under the above conditions. The possible reasons for this are dealt with later, and in order to determine the correctness or otherwise of the series field the following procedure is recommended:—

Disconnect the lead from the equaliser switch to the machine *not* being tested, and instead run a heavy cable from the switch to the series field of the generator to be tested, connected so that when the switch is closed the series field only is short-circuited.

Put the generator under test on a steady load, anywhere between half and full load will do. With the short-circuiting switch open read the terminal volts, noting also the speed and load. Close the switch, thus short-circuiting the series field. If the volts rise, the series field is opposing the shunt. If the volts fall the series field is aiding the shunt, and therefore correctly connected. The speed must be kept constant during the test.

If it is impossible to obtain load for the generator, the following method is recommended:—Separately excite the shunt field of the generator under test with current flowing in the same direction as when self-excited. Test the polarity of each pole at the armature end by means of a soft iron bar and a compass. Remove the shunt excitation and excite the series field with current flowing in the same direction as when the generator is running on load. Test the polarity of the poles as before. Similar polarity indicates a correct or additive compounding. Opposite polarity shows the series to be opposing the shunt. Care must be taken not to reverse the polarity of the compass during test.

Whatever the result of the above test, it would be as well to make the following tests to ascertain why the compounding has so little effect:—(1) If the series field has a diverter or shunt, measure the current passing through this diverter, and if large, say more than 30 per cent. of the total current, the compounding of the generator, if found to be cumulative, may be improved by a new diverter on each generator of a higher resistance. (2) Test the speed regulation of the driving mechanism, as poor regulation will give bad compounding. (3) The brush position of both generators may be wrong; as excessive forward lead will give poor compounding. (4) If a diverter is fitted, test the joints in the series field; these may be making poor connection, thus increasing the resistance and driving the current through the diverter—the result again being poor compounding. The test may be made by means of a low-reading voltmeter. The drop across any joint should be practically nil, certainly not more than 0·05. The remedies are obvious.

In a reply by "Beta" to this question, it is pointed out that if the direction of the interpole winding can be seen by inspection, the direction of the shunt winding on each pole may be inferred:—"The main pole must have the same polarity as the interpole preceding it—going round the machine in the direction of rotation. The interpoles may be considered as correctly wound, for if they were not, commutation would be very bad, and this is presumably not giving trouble in the present case."

This, of course, is quite definite and simple if it can be applied, though frequently interpole coils are taped up or so constructed that their direction cannot be seen by inspection.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published April 20th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

4,593/15. **Communication with Aeroplanes.** H. A. VON POST. A method of paying out a telephone wire from an aeroplane at great speed, in which the wire supported by a strip of textile material is zig-zagged upon itself as well as being wound on a drum, so that a much greater length is paid out than that corresponding to the rotation of the drum. The drum is driven through gearing by the engine, and controlled by clutches. (Four figures.)

4,953/15. **Telephony.** H. SMITH. Apparatus for increasing the sound in telephones and telegraphones, consisting in a diaphragm on the two sides of which are mounted a coil connected at one end to a microphone on one side of the diaphragm, a coil inductively connected to this coil and connected at one end to a microphone on the other side of the diaphragm, a source of electrical energy connected to these coils by wires connecting them in parallel, and wires connecting the coils in series. (Two figures.)

7,081 and 7,082/15. **Transformers.** B.T.-H. Co. (*G.E. Co., U.S.A.*) The first describes a winding for transformers, comprising a number of sections separated from each other, and having substantially uniform distributed capacity. The second covers the connection of sections of transformer windings in series or parallel to obtain different secondary voltages. (Three and four figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: RICHARDS [Insulating material] 3,364/15.

Dynamos, Motors and Transformers: BOIN [Dynamos] 5,079/15; B.T.-H. Co., SHUTTLEWORTH and BROWN [Dynamos] 5,260/15; WOOD, FURLONG & FERRANTI, LTD. [Transformer tappings] 10,422/15.

Heating Apparatus: THYNNE [Electric stove] 17,713/15.

Ignition: KENNEDY McGREGOR [Sparking plug connections] 9,903/15.

Incandescent Lamps: R. BOSCH [Metal filament projector lamp] 17,542/15.

Instruments and Meters: WEST [Measuring instruments] 8,028/15.

Switchgear, Fuses, and Fittings: ELECTRIC & ORDNANCE ACCESSORIES Co. [Controllers] 9,706/15; ROOTHAAN and FERRANTI, LTD. [Rheostat switches] 10,598/15.

Telephony and Telegraphy: SHIBKO [Telephone meter relays] 5,088/15; BELLINI [Wireless telegraphy] 17,455/15.

Traction: HAMILTON [Electric luggage truck] 10,325/15.

Miscellaneous: LANDIS & GYR A.G. [Spring make and break devices) 5,007/15; MURRAY and SHOTTER [Electromagnetically-operated devices] 5,200/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Apparatus for discharge through gases, &c.] 5,741/15; HOPPIE [Batteries] 8,204/15; PATTERSON [Electric miners' lamps] 9,003/15; GIANDINOTO and SCUDERI-SCUDERI [Apparatus for converting currents] 10,518/15; GLOYNE ["Perpetual magnetic power wheel"] 11,050/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Heating: L. HELLER [Heating devices] 4,901/16 (*100,230*).

Miscellaneous: ELECTRICAL BOAT Co. [Propulsion of vessels] 826/16 (*100,221*); C. F. KETTERING and W. A. CHRYST [Engine starter] 4,688/16 (*100,228*).

Amendment made

28,409/13. **Telegraphy.** F. G. SARGENT. A reference has been inserted in this specification, which is for A.B.C. or type printing wireless systems, to No. 3,371/14 of F. de Bernochi for printing telegraphs.

Opposition to Grant of Patents

The grant of a patent on the following application has been allowed in spite of opposition:—

23,676/14. **Heating Apparatus.** F. S. GROGAN. A heating element composed of flat metallic tape coiled into a helix with slightly separated convolutions. When a number of these are assembled into a grid, the convolutions near the centre of the grid are spaced farther apart than at the edge to equalise the temperature.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

9,803/02. **Electrolysis.** M. WILDERMANN. A form of cell with superposed mercury troughs for electrosis of alkaline salts.

10,181/02. **Wireless Telegraphy.** O. T. LODGE and A. MUIRHEAD. A syntonic system applicable to automatic or duplex working.

10,245/02. **Wireless Telegraphy.** G. MARCONI and MARCONI'S WIRELESS TELEGRAPH Co. A form of magnetic detector.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, &c.: H. A. MAVOR and MAVOR & COULSON [Traction motors with sliding polepieces remaining concentric with the armature, but displaceable as regards the field frame] 57/08.

Electrochemistry and Electrometallurgy: A. PETERSSON [Electric furnaces] 27,674/09.

Incandescent Lamps: W. SHÄFFER [Lamps with flat metal filaments] 28,554/08.

Instruments and Meters: G. C. FRICKER and W. M. MORDEY [Induction type meters] 129/09.

ELECTRIC TRACTION NOTES

Arrangements have been made for the annual congress, which, as we have already announced, will take place on June 30th. The meeting will commence at 2.30 p.m. at the Westminster Palace Hotel, when the ordinary business of the annual general meeting will be transacted. At 3 p.m. a Paper will be read by Mr. W. T. Robson, general manager of the Southampton Corporation Tramways, after which a visit will be paid to the training school of the London General Omnibus Co., Milman Street, Chelsea, where Mr. H. Blain, the operating manager, will give a short address on "The Safety Movement." The members' dinner will be held at the Trocadero, at 7.30 for 7.45.

As we mentioned some time ago, the experiment with trolley omnibuses in Brighton and Hove was abandoned in consequence of the general position due to the war, but in order to avoid the lapse of the Parliamentary powers, the Brighton Corporation has asked the Hove Corporation to join with it in an application to Parliament for a five years' extension of the time of these powers.

The Manchester Tramways Committee has decided to contribute £100,000 to relief of rates for the year 1916–17, but, as in the case of the Electricity Committee, mentioned in our "Local Notes" columns, it will be necessary to draw upon the reserve fund, in this case to the extent of £10,865. This rate contribution was fixed by the City Council three years ago, and was to continue for three years, so that a rearrangement will probably be made at the end of the current year.

The high-tension continuous-current line between Manchester and Bury (ELECTRICAL ENGINEERING, Jan. 27th, p. 31, and Feb. 3rd, p. 39) has now been put into regular operation.

The strike of the tramway workers in the Croydon district practically collapsed on Tuesday. The trouble originated amongst the South Metropolitan Electric Tramways & Lighting Co.'s men, who came out on strike in the belief that the Company intended to introduce women drivers. Subsequently, however, Mr. A. V. Mason, the manager, stated that it was not the intention to do this, and he invited the men to return to work. Meanwhile, however, the trouble extended to the Croydon Corporation Tramways, between which and the South Metropolitan Co. a running-powers agreement exists. By this time both sets of employees had formulated demands for improved conditions, and although the South Metropolitan Co. is willing to refer these to arbitration, and their employees have returned to work pending this, the Croydon Corporation has refused to fall into line on the ground that whereas at present the profit on their undertaking only amounts to a few hundred pounds, the men's demands would involve several thousand pounds per annum.

SPEED CONTROL OF A.C. MOTORS

A GENERAL descriptive account of various types of alternating current motors, with particular reference to their adaptability to speed control, was given by Mr. H. C. E. Jacoby in a recent Paper before the Association of Supervising Electricians. A.C. motors were considered under two heads: (1) synchronous motors, ordinary and self-starting, and (2) asynchronous motors, including series, induction, repulsion, compensated repulsion, and mixed motors. The greater part of the Paper is devoted to the latter types.

The ordinary polyphase induction motor may be regulated in speed by the following methods:—(1) Varying the periodicity of the supply. (2) Varying the voltage. (3) Resistance in the rotor circuit.

(1) Speed control by varying the supply frequently is, theoretically, an ideal means of control, but is not feasible from a practical point of view under ordinary conditions.

(2) Will only allow a very limited speed control, which is not very satisfactory.

(3) This is the usual method, and is quite satisfactory (except from an economical point of view), in all cases where a series characteristic is permissible. This method is wasteful in power, and, roughly speaking, the watts consumed at all speeds under constant torque are the same. That is to say, power is wasted in the controlling resistance which will be directly proportional to the decrease in speed. At half-speed, half the power will be wasted. At crawling speed, practically all the power will be wasted. The power factor will remain nearly constant for the value for full speed on the particular torque at which the motor is running. Consequently this method is much to be recommended from the supply company's point of view. This method of control may be used for all speeds down to crawling, provided that the rotor is suitably wound.

Single-phase Motors.—Single-phase motors of the induction type do not permit speed regulation of more than 10 or at the outside 20 per cent. Speed regulation of 10 per cent. can be obtained by means of resistance in the rotor circuit, similar to that described for polyphase motors. It must be borne in mind that the percentage slip of single-phase motors is half the percentage loss in the rotor windings. Consequently, to reduce the speed by 10 per cent., we will require a resistance absorbing a little more than 20 per cent. of the synchronous H.P. to which the motor is loaded. The motor is liable to fall out of step and stop if the speed is decreased too far; consequently, this method of regulation cannot be used except for small variation in speed. Regulation, by means of varying the periodicity and voltage in the same ratio, is satisfactory, but cannot be employed in ordinary practice. Cascade connections are not practicable with single-phase motors.

It is now common practice to supply single-phase motors with a commutator which allows of a large number of variations in the design of the motor. The commutator motor may be arranged for:—(1) high-starting torque; (2) speed control; (3) unity power factor; (4) any combination of these properties.

(1) A common form of commutator motor is that known as the repulsion induction type. The stator is similar in design to the standard induction motor, but there is only one winding. The rotor is fitted with a commutator and brushes which are short-circuited. A mechanical governor is arranged to short-circuit the rotor when synchronous speed has been attained. The motor starts as a repulsion motor, and after the governor has acted, runs as an induction motor. The best-known forms are the "Wagner" motor, the "Century" motor, and the "Bandy" motor. An earlier type of motor, devised by Schuler, was fitted with both commutator and sliprings. The rotor had a double winding, one connected to the commutator and the other to the sliprings. A starting resistance was arranged so that resistance was intercalated in the slipring circuit when the motor started. This was gradually cut out as the motor attained speed, and the resistance inserted into the commutator circuit. The motor had very good starting properties, but was large for the output on account of the double winding.

(2) Speed control is easily obtained on commutator motors by means of: (*a*) Primary resistance. (*b*) Voltage variation by means of auto-transformers. (*c*) Brush shifting. (*d*) By means of stator tappings.

(3) For this purpose, two sets of brushes are required per pole. If the rotor is series connected, four sets of brushes will suffice for any number of poles. The brushes must be placed 90 electrical degrees apart. Such a motor, without further complications, will run with similar characteristics to the ordinary induction motor, but the power factor is low. The axis of one set of brushes, known as the *yy* or energy brushes, are arranged along the axis of maximum magnetisation. The second set, known as the *xx* brushes, or exciting brushes, are arranged at 90 electrical degrees, or midway between the *yy* brushes. To compensate the motor, that is to bring it up to unity power factor, an electromotive force must be introduced into the *xx* brush circuit. This may be arranged in a variety of ways, of which the following are the better known:—(1) The use of an auxiliary transformer, with the primary connected across the supply mains, or in series, as in the Winter-Eichberg motor. (2) *xx* brushes may be connected to an auxiliary winding on the stator, having its polar axis along the *yy* line. (3) The *xx* brushes are connected to a portion of, or tapping on, the stator winding. (4) Both *yy* and *xx* brushes are sometimes joined through auxiliary windings on the stator, the windings connected to the *yy* brushes being on the axis of the *xx* brushes and *vice versa*. Self-starting characteristics can be obtained by shifting the brushes about 15 electrical degrees from the theoretical axis.

Polyphase Motors.—If a polyphase motor has a rotor fitted with a commutator, connected to a winding which is generally similar to an ordinary direct-current armature, speed regulation can be obtained by varying the voltage on the stator, either by series resistance or by the use of an auto-transformer. The speed cannot be varied by shifting the brushes, which should be in the position of correct phase relationship with the stator. The motor in this simple form has rather a poor power factor, generally about 80 per cent. Three sets of brushes are required per pair of poles, that is to say, a four-pole motor will have six brushes, an eight-pole motor twelve sets of brushes, and so on. Curiously, a six-pole motor will have $6/2 \times 3 = 9$ sets of brushes, which is rather puzzling to the purely D.C. man. By series connecting the rotor windings, three sets of brushes may be made to do duty for any number of poles. The motor can be regulated in speed in a number of other ways, by introducing an electro-motor force between the brushes, which will either increase or decrease the current in the rotor. The necessary E.M.F. can be obtained in a variety of ways, of which the following are the most usual:—1. By means of external transformers. 2. By means of extra windings on the motor. The former is the more usual method, and has the advantage that extra space is not required in the motor for the additional windings. The transformers may be connected in shunt or series concatenation.

The speed of the motor can be regulated in two different ways:—(1) By varying the ratio of the turns on the transformer, by cutting in and out turns by means of a multiple contact switch, which must be arranged so that contacts are not bridged when passing from one to the other. (2) The more usual method is by shifting the brush position. By this means a continuous speed regulation is obtained—that is to say, the motor can be run at any speed in a gradual crescendo or diminuendo. Speed regulation between top speed and half speed, is quite satisfactory. Speeds below half speed, down to zero speed, can be obtained, although it is not generally satisfactory to do so, except for short periods.

The following explanation of the action of the motor, although not quite theoretically correct, will help to make the action clear. Suppose that the windings on the auxiliary transformers are so proportioned that, when the brushes are in the position of maximum speed, the currents in the primary and secondary windings of the transformer have equal ampere turns. As the connections are such that the currents in the primary and secondary windings oppose each other, it is clear that, under this condition, there would be no resultant magnetization in the transformer iron. Consequently, the net result would be merely that of a slightly added resistance to the rotor and stator circuit, and the motor will run as if the brushes were short circuited. Now, suppose that the brushes are moved from this position, a little consideration will show that the phase of the current in the secondary will be displaced relatively to the phase of the current in the primary. Consequently, there will be a resultant magnetisation in the transformer iron. It is evident that if the brushes are displaced sufficiently, the effect is that of reversing the connections between the brushes and the transformers; so that the currents in the primary and secondary winding, instead of opposing each other, will be assisting each other (that is, the phase has been shifted 180 degrees). Under this condition, the volts on the stator windings will be reduced, owing to the opposing E.M.F. of the transformer primary, and the transformer secondary will oppose the rotor current. Torque will consequently be reduced and the motor will run at a slower speed. The actual size of the auxiliary transformers necessary to reduce the speed of the motor down to zero is only 7½ per cent. of the rated output of the motor. By choosing a suitable transformer ratio, an E.M.F. can be impressed on the commutator circuit, and the power factor brought up to unity at synchronous speed and full load.

Endless variations of this method of control can be arranged. Tappings can be brought out from either or both transformer windings, and the ratio altered by cutting in and out turns. If the transformers are connected in shunt concatenation, a shunt characteristic can be obtained, but much larger transformers must be used. It must be borne in mind when installing these motors that the sequence of the phases must be correctly connected. A simple apparatus for determining the sequence of the phases of the supply companies' mains can easily be made by winding a small ring of wood or any suitable substance with a few turns of wire similar to a gramme ring. Tappings are taken off three equi-distant points, which are connected with the supply companies' mains, through a suitable resistance, such as a lamp. If an ordinary compass is introduced into the centre of the ring the needle will rotate, the direction of rotation being the same as that of the rotary field set up.

LOCAL NOTES

London: *Poplar: Increase in Charges.*—Although the Poplar electricity undertaking has been extremely successful during the past few years, nevertheless the continued increase in costs of production has at last compelled the Electricity Committee to increase the charges. As a first step a temporary increase of 10 per cent. in the charges for current for power purposes and public lighting is proposed, leaving the charges for private lighting untouched. This increase compares with an increase of 15 per cent. in Stepney, 17½ per cent. in Hackney, and 12½ per cent. in West Ham.

Manchester: *Electricity Rate.*—The Electricity Committee has decided to allocate £30,000 to the relief of rates from the electricity undertaking for the year 1916–17, but in order to do so it will be necessary to withdraw from the reserve fund £10,057. It is anticipated that sales will increase by some 42 million units.

Tynemouth: *Electrical Engineer's Report.*—The result of the past year's working was a net profit of £738 against £1,178 in 1914–15. This reduction in profit is the natural result of the augmented cost of working, there having been an increase in output of over half a million units. Mr. C. Turnbull, the borough electrical engineer, has compiled quite an interesting report upon the general position of the electrical industry, in which he deals with the necessity for removing the restrictions on overhead wires in order that electricity may be supplied cheaply for agricultural purposes, developments in electric traction, the improvements in metal filament lamps, and, incidentally, the high price of half-watt lamps, the increasing use of the electric vehicle, and the considerable scope which still exists for economy in burning coal. Finally, reference is made to scientific research work, and a comparison is drawn between the large sums of money spent in the United States and other countries for this purpose, and the very much smaller sums allowed in this country.

Weymouth: *Electricity Undertaking and the War.*—The war has had a rather serious effect upon the electricity undertaking, the estimated loss for the current year being £1,500, the deficiency for 1915–16 amounting to £1,000. Consequently it is not surprising that the Committee have persuaded the Council to agree to a 15 per cent. increase in prices.

APPOINTMENTS AND PERSONAL NOTES

An agreement has been concluded with Mr. Clifford C. Paterson, M.I.E.E., principal assistant in charge of the electrotechnical and photometric buildings at the National Physical Laboratory, to join the staff of the Osram-Robertson Lamp Works, Ltd., as Director of Laboratories for research and technical manufacturing purposes. The arrangement will commence at the conclusion of the war, or before that date if possible.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The Melbourne City Council requires a supply of meters. Tenders to the agents, Messrs. McIlwraith, McEacharn & Co., Billiter Square Buildings, London, E.C., by May 1st. A copy of the specification, &c., can be seen at 73 Basinghall Street, E.C.

The Sydney Corporation require four 40-h.p., three 60-h.p., and two 100-h.p. A.C. slip-ring type induction motors and starters. Further particulars at 73 Basinghall Street, E.C., and tenders to the City Electrical Engineer, Sydney, N.S.W., by May 29th.

The Victorian Railway Commissioners require transformers with terminal and fuse boxes during a period of five years. The first order will comprise 220 transformers complete to be delivered in six months. Tenders to Spencer Street, Melbourne. This information is only of use to firms who can cable agents.

Glasgow.—The Corporation requires twelve months' supply of cables and meters. City Electrical Engineer, May 4th. (See an advertisement on another page.)

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £139 to £141 (last week, £137 to £139).

Advertising Service.—A forceful little booklet has been issued by the Greenly Advertising Service, 37 and 38 Strand, W.C., entitled "Preparedness," which in a few words explains the service they are offering. This service acts as advertising manager on a monthly salary basis—a plan which has proved to be most satisfactory.

Ediswan Telegraphic Address.—In order to expedite delivery of telegrams, the Edison & Swan United Electric Light Co., Ltd. (Ponders End, Middlesex), would be glad if their customers would in future address all telegrams "Ediswan, Enfield," when communicating with the Ediswan works.

Liquidation.—Mr. Justice Neville last week granted an order for the compulsory winding-up of Cedes Electric Traction, Ltd., on the petition of the Tudor Accumulator Co. It was stated that the debenture holders are in possession, and are trying to arrange a scheme.

Brush Electrical Engineering Co.—At the annual meeting last week the report and accounts given in our issue for April 13th were adopted. Mr. E. Garcke, the Chairman, made special reference to the success of the Ljungstrom turbine, which even during the war has been supplied to a considerable number of places with gratifying results. Orders are now in the course of execution for Japan and New Zealand. Arrangements are being made here for manufacture on a larger scale, but naturally the delivery of the necessary machine tools has been delayed. The company, in common with so many others, has suffered in its general turn-over through being a controlled factory under the Munitions Act. Although Treasury consent has been obtained to the issue of the balance of second prior lien debenture stock, upon which at prsent 10 per cent. is paid, the Directors have deemed it wisest not to issue this at the present moment, but to utilise all profits and temporary loans to provide cash for capital expenditure.

ELECTRICAL ENGINEERING.

The Engineering Journal of the Electrical Industry

With which is Incorporated

THE ELECTRICAL ENGINEER

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The Government has decided that strict economy in paper is necessary, and, in consequence, to prevent waste, the majority of newsagents and bookstalls will limit their stocks so far as possible to the actual known requirements of their customers. A mere verbal order will, however, be sufficient to ensure that a copy is sent or reserved weekly.

"Electrical Engineering" can also be sent direct to readers by post. Copies are posted on Wednesday evening, and should reach readers in practically every part of the United Kingdom on Thursday (in London, and many other towns, by first post). Orders, with a remittance of 6s. 6d. for one year, 3s. 3d. for six months, or 1s. 8d. for three months, which includes postage (Colonies and Abroad 8s. 8d. per annum), should be sent to the Kilowatt Publishing Co., Ltd., 203, Temple Chambers, London, E.C.

SUMMARY

THE building of a large central power station at Sheffield was suggested at a meeting of the Sheffield Society of Engineers and Metallurgists, as a means of effecting considerable fuel economy in the district (p. 156).

IN a Paper on Electric Winding, Prof. D. Burns has worked out, as an example, the data for an electric winding plant for a particular case (p. 156).

THE subjects of the Patent Specifications relating to electric mining and metallurgical work published during April include mine signalling systems, non-sparking bells, safety lamps and electric furnaces (p. 158).

A PAPER on the subject of electric furnaces as applied to non-ferrous metallurgy, by Dr. Alfred Stansfield, of McGill University, was presented at the annual meeting of the Institute of Metals on March 29th. Electrolytic and electrothermic smelting furnaces are the chief types dealt with (p. 159).

MR. W. STEWART, in his Presidential Address to the South Wales Institute of Engineers, dwelt upon the importance to colliery owners and officials of encouraging technical education and research in the mining industry (p. 159).

WE give a description of an electric steel furnace installation at the works of the Lebanon Steel Foundry, Pa., U.S.A. A 1-ton furnace of the Heroult type has been in successful operation for twelve months, and the installation of one of 2 tons capacity is arranged for. The latter is to be supplied through a transformer having a reactance drop of 10 per cent. in order to limit variations in load and large current rushes on short circuit (p. 160).

ELECTRICALLY-WORKED charging waggons for coke-ovens have chiefly been used only on new plants, as the construction of the hand-charged ovens did not adapt itself well to the purpose. A description of some electrical-charging waggons made for an existing installation in Germany appears on p. 160.

THE Annual Report of the Institution of Electrical Engineers records a number of military distinctions gained by members. Over 1,300 members are serving in the forces, of whom 34 sacrificed their lives during the past year (p. 161).

SOME useful work on "telephonometry" has been done by Mr. B. S. Cohen at the Post Office. The telephone service at Portsmouth was changed over on Saturday last to the automatic system. The new system is designed for a maximum of 9,999 subscribers. Three local exchanges in the borough were involved in the change (p. 161).

WE give the terms of a resolution passed by the B.E.A.M.A. urging the Government to formulate a scheme of tariffs dealing with Imperial trade (p. 162).

AN interesting account is given of a carbon-iron-oxygen cell, defying the laws of the conservation of energy, which Dr. Just (one of the inventors of the metal-filament lamp) thought he had discovered (p. 162).

OUR Questions and Answers page this week deals with the subject of the instantaneous value of the current in a turbo-alternator when a short circuit occurs whilst the machine is on full load (p. 163).

AMONG the subjects of specifications published at the Patent Office last Thursday were insulators, relays, load equalisation and discharge tubes. Application has been made for the suspension of enemy-owned patents for X-ray apparatus, and licences have been granted in respect of tramway rail welding patents (p. 164).

THE Society of Motor Manufacturers and Traders has been asked to nominate a representative to sit on the Electric Vehicle Committee (p. 164).

THERE were 3,244 cards issued in connection with the ballot of members of the Institution of Electrical Engineers as to the manner in which enemy members are to be dealt with. The number returned was 1,470, and there were large majorities in favour of the proposals formulated (p. 164).

A WAGES dispute at Marylebone has ended in favour of the Electricity Department (p. 165).

GENERATING plant is required at Greenock and Nelson (p. 165).

ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEERS CORPS

COMPANY ORDERS BY LIEUT.-COL. C. B. CLAY, V.D.
Drills, 6.25 to 7.25: 7.25 to 8.25 p.m.

(To-day) Thurs., May 4th: Shooting for Sections 1 and 2, and Signalling Class. Recruits, 5.45 to 7.45 p.m.

Fri., May 5th: Sections 2 and 4, Technical; Sections 1 and 2, Squad and Platoon.

Mon., May 8th: Sections 1 and 2, Technical. Sections 3 and 4, Squad and Platoon. Signalling Class and Recruits.

Tues., May 9th: School of Arms, 6.0 to 7.0 p.m. Recruits' Drill, 7.15 to 8.15 p.m.

Thurs., May 11th: Shooting for Sections 3 and 4. Recruits, 5.45 to 7.45 p.m.

Fri., May 12th: Sections 3 and 4, Technical. Sections 1 and 2, Squad and Platoon. Signalling Class and Recruits.

Sat., May 13th: Adjutant's Instruction Class at 2.30 p.m.

Sections for Technical Parade at Headquarters, London Electrical Engineers, 46 Regency Street, S.W.

Sections for shooting parade at miniature ranges.

Unless otherwise stated, all parades at Chester House.

Arrangements for the Week.—*Friday, May 5th.*—Royal Institution. Discourse by Sir James M. Davidson on "Electrical Methods in Surgical Advance," 5 p.m.

Monday, May 8th.—Royal Society of Arts. Cantor Lecture, II.: "Vibrations, Waves, and Resonance," by Dr. J. Erskine-Murray. 4.30 p.m.

Tuesday, May 9th.—Illuminating Engineering Society. Annual General Meeting at Royal Society of Arts. A report will be presented by the Research Committee. 8 p.m.

Thursday, May 11th.—Institution of Electrical Engineers. Annual General Meeting. 8 p.m.

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

FUEL ECONOMY AND LARGE POWER STATIONS

At the discussion on the electricity supply of Great Britain at the Institution of Electrical Engineers last month, it was observed by one of the speakers that the centralisation of supply was highly desirable in the interests of fuel economy. The truth of this observation was emphasised at a meeting held on April 6th at Sheffield, under the auspices of the Sheffield Society of Engineers and Metallurgists, to consider the question of fuel economy after the war, when several speakers advocated the building of a large central power station for the Sheffield district. Professor Bone, chairman of the committee appointed by the British Association to deal with the question of the conservation of our fuel supplies (see ELECTRICAL ENGINEERING, March 30th, page 115), said that only a small fraction of the total coal reserves of the world were located in this country, and our whole economic future was dependent on our ability to maintain abundant supplies of cheap coal. Seven-tenths of the seaborne trade of the world was now carried on by us, and he thought that an export duty of one shilling per ton was feasible, without any risk of injury to the trade. This would produce five million pounds per annum, which he suggested should be ear-marked by the Treasury for financing experiments in the direction of fuel economy.

The loss of coal to the country through the custom of working only the best coal, and the necessity of dealing with inferior coals, which could be done by the use of gas producers, was mentioned by Mr. G. Blake Walker. He thought that by the use of a large central power station electricity might be produced at a cost of 0·25d. per unit. This would greatly facilitate economies at the collieries, and the extended use of electricity for general purposes in Sheffield. The practice adopted by manufacturers of producing their own power he thought to be very uneconomical. Professor O'Shea made reference also to the enormous amount of waste gas that was being made from ovens in the big coalfield of South Yorkshire, much of which was burning away uselessly at stand pipes. Much of this ought to be beneficially applied, as, for instance, was done by Mr. Blake Walker, the pioneer of by-product ovens in this part of the country, who had utilised this gas for electrifying his colliery.

The erection of a large power station in Sheffield was also advocated by Professor Ripper, who referred to the almost unlimited power available in the great coalfield surrounding the city. Sheffield would receive immense benefits if current could be produced at the figure mentioned by Mr. Walker. Present industries would be revivified, and a number of new ones introduced. Government control of the electricity supply of the United Kingdom was advocated by Mr. S. E. Fedden, manager of the Corporation electricity department. He suggested the appointment of an Electricity Minister, and was in favour of the erection of big power houses in suitable positions throughout the country. He said that if dumping of foreign goods was stopped, efficiency and economy would be secured by enabling the works to carry on at a good load factor and lower standing charges.

ELECTRIC WINDING

A PAPER on "Electric Winding" was read by Professor D. Burns, on Jan. 22nd, at a joint meeting in Glasgow of the Scottish Branches of the Association of Mining Electrical Engineers and National Association of Colliery Managers and the Mining Institute of Scotland.

The method of dealing with the problem was illustrated by selecting a hypothetical example.

It is desired to raise an output of 640 tons of coal in eight hours from a shaft 150 fathoms deep, *e.g.*, the hutches hold 10 cwts. of coal and weigh 4 cwts. when empty. The problem is to find a cage load and horse-power of the motor for a maximum speed of, say, 40 ft. per sec. in the shaft.

Cycle of Operations.—It will require 160 hutches per hour to deal with the output, and as two hutches must be drawn per wind, this gives 80 winds per hour, and the time per wind is 45 secs. Allowing 15 secs. for changing hutches at top and bottom, these operations being simultaneous, the running time will be the total time per wind *minus* time for changing, viz., 30 secs.

With uniform acceleration and retardation, the average speed from rest to maximum and from maximum to rest is 20 ft. per sec. If the period of acceleration is fixed at 10 secs., and the period of retardation at 5 secs., we get the following :—Acceleration, 10 secs., distance load moves 200 ft.; retardation, 5 secs., distance load moves 100 ft. The sum of these two periods gives 300 ft. travelled by the load, leaving 900−300=600 ft. to be travelled during the full-speed period. Since the load moves at 40 ft. per sec. during this period, the time taken to travel 600 ft. is 15 secs.

We can now state the cycle of operations as follows :—Acceleration, 10 secs.; constant speed, 15 secs.; retardation, 5 secs.; changing, 15 secs.; total time per wind, 45 secs.

Weights.—We next turn our attention to the strength, weight, and size of the winding rope; and to ascertain these we must make up a table of weights.

	lbs.
Weight of cage and chains (say, 1¼ times weight of coal)	2,800
Weight of coal ...	2,240
Weight of hutches ...	896
Friction (15 per cent. of load) ...	1,120
Weight of rope (say) ...	1,568
Pull due to acceleration ...	616

A preliminary calculation shows the weight of the rope to be about 10 lbs. per fathom, or roughly 14 cwts.

Since the load is uniformly accelerated from rest to a speed of 40 ft. per sec. in 10 secs., the rate of acceleration is 4 ft. per sec. per sec. The unbalanced load which has to be accelerated consists of the weight of coal+friction+weight of rope, viz., 4,928 lbs. The force in poundals required to produce this acceleration is, therefore, 4,928×4=19,712 poundals, or $\frac{19,712}{32}=616$ pounds weight.

Rope.—The total load on the rope, exclusive of its own weight, is 7,672 lbs.

Assuming the rope to be constructed of six strands of 19 wires each, and the breaking stress of the steel to be 120 tons per sq. in., the size and weight of the rope are given by the following :—

$$W=\frac{G}{\frac{L\times S}{100\times F}-D}$$

where W=Weight of rope in lbs. per fathom.

G=Total weight at end of rope in lbs.

L=Length of rope in fathoms which is just self-supporting when constructed from steel of a tensile strength of 100 tons per sq. in.; for the type of rope considered this length is 7,350 fathoms.

S=Ultimate strength of steel used, in tons per sq. in.

F=Factor of safety; 10 for a winding rope.

D=Depth of the shaft in fathoms.

Substituting the numerical values in the above formula :—

$$W=\frac{7,672}{\frac{7,350\times 120}{100\times 10}-150}=10{\cdot}4$$

(Circumference of rope in inches)^2=weight in pounds per fathom. Therefore circumference=$\sqrt{10{\cdot}4}=3{\cdot}2$ inches.

The rope diameter is $\frac{3{\cdot}2}{3{\cdot}14}=1$ inch approximately.

The diameter of the drum may be taken as 120 times the diameter of the rope, *i.e.*, 10 ft. The pulleys for the headgear should also be of the same diameter.

In an actual case the drawings for the drum would be made, and the weight and the radius of gyration taken out from the drawings. For our purpose we will take the ratio between the static load (load+friction) and the mass of the drum to be 1·25 to 1, a ratio which is fairly common in practice.

Drum.—Having found the weight and the radius of gyration of the drum and the other rotating parts, such as headgear pulleys and motor armature, they are all reduced to the drum diameter by applying the formula

$$\frac{W\times K^2}{G\times R^2}=x$$

where W=weight in lbs., K=radius of gyration of rotating part,

R=radius of drum, G=gravity, and x=equivalent weight at radius of gyration of arm.

The unbalanced load consists of the coal, 2,240 lbs., and the rope, 1,568 lbs., giving a total of 3,808 lbs. Adding 15 per cent. for friction, we get roughly 2 tons, or 4,480 lbs. The drum weight is $2\times1{\cdot}25=2{\cdot}5$ tons, and the radius of gyration, say, 4 ft.

Reduced to drum radius, this is $\frac{5,600\times4\times4}{32\times5\times5}=112$ lbs., which at 4 ft. per sec. per sec. acceleration requires an accelerating force of 448 lbs.

Two headgear pulleys of, say, 10 cwts. each, and radius of gyration 4 ft., when reduced to drum diameter gives $\frac{(1,120+1,120)\times4\times4}{32\times5\times5}=45$ lbs., which at 4 ft. per sec. per sec. requires an accelerating force of 180 lbs.

Taking armature weight at 3 tons, and radius of gyration as 1 ft., we get $\frac{6,720\times1\times1}{32\times5\times5}=8{\cdot}4$ lbs., which at 4 ft. per sec. per sec. acceleration requires an accelerating force of 33·6 lbs.

We have already worked out the accelerating force for the unbalanced static load in the shaft as 616 lbs., so that the total force for acceleration is $448+180+33{\cdot}6+616=1,277{\cdot}6$, say, 1,278 lbs.

We can now proceed to draw the speed, torque and power

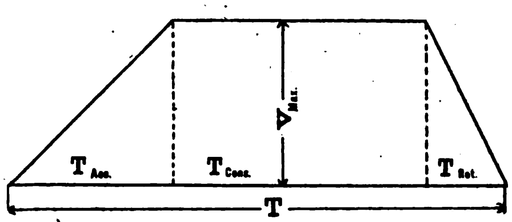

FIG. 1

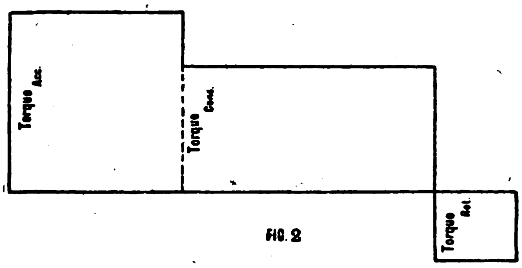

FIG. 2

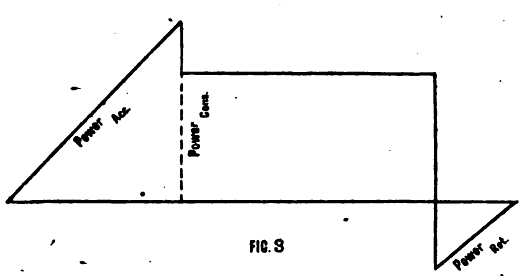

FIG. 3

diagrams from these data. These are best drawn on one sheet, and on a base corresponding to the time taken to complete one run from the pit bottom to the pit top.

Speed Diagram.—(Fig. 1.) The maximum height of the diagram represents the maximum velocity, $V_{max.}$, and the average height represents the mean velocity, $V_{mean.}$ But the area of the diagram is obtained by multiplying the length of the base T by the average height, hence the area of the diagram gives the depth of the shaft.

Let A=area of diagram, T_{acc}=time of acceleration, T_{ret}= time of retardation, T_{cons}=time of full speed, and T=total running time, all in seconds, then $A=V_{max}\times(T-\frac{T_{acc}+T_{ret}}{2})$,

$T_{acc}+T_{ret}=2T-\frac{2A}{V_{max}}$, and $V_{max}=\frac{2A}{T+T_{con}}$.

Torque Diagram.—(Fig. 2.) This diagram is plotted to the same base as the speed diagram, and is derived therefrom It should be noted that the total pull in the winding rope is due to several forces. Thus, let P_1=force required to overcome the unbalanced load, P_f=force required to overcome friction, P_{acc}=force required to accelerate the masses in motion, P_{ret}=force required to retard the masses in motion, and P=total pull in rope. Then $P=P_1+P_f+P_{acc}$ and since torque is the moment of a force about an axis, we have plainly three

separate moments to consider: (1) the moment during acceleration, (2) the moment during constant speed, and (3) the moment during retardation. Therefore—

Torque (acceleration) $=(P_1+P_f+P_{acc})\ R$,
Torque (constant) $=(P_1+P_f)\ R$,
Torque (retardation) $=(P_1+P_f-P_{ret})\ R$,

where R is the radius of the drum in feet, the result being in pound-feet units.

Substituting in the torque formula the value of the various forces already given in the table of weights, and that calculated as the total force due to acceleration, we get:—

Torque (acceleration) $=(3,808+1,120+1,278)\ 5=31,030$ pd.-ft.
Torque (constant) $=(3,462+1,120)\ 5=22,910$ pd.-ft.
Torque (retardation) $=(2,413+1,120-1,278)\ 5=11,275$ pd.-ft.

It may be observed at this point that the weight of the rope has been taken as diminishing at each step, instead of uniformly through the run; this simplifies matters and makes no material difference in the ultimate result. With a heavier rope and a deeper shaft it would be advisable to consider the uniform decrease of rope weight on the load side and the corresponding increase on the empty side.

Power Diagram.—Since work is the product of force and distance, and power is the amount of work performed in a given time, it is obvious that the power diagram (Fig. 3) can be plotted on the same time base as the speed and torque diagrams, thus—

Power (acceleration) $=(P_1+P_f+P_{acc})\ V$,
Power (constant) $=(P_1+P_f)\ V$,
Power (retardation) $=(P_1+P_f-P_{ret})\ V$,

where V is the velocity in ft. per sec.

Substituting values we get—

Power (acceleration) $=(3,808+1,120+1,278)\ 20=124,120$ ft.-lbs.
Power (constant) $=(3,462+1,120)\ 40=183,280$ ft.-lbs.
Power (retardation) $=(2,413+1,120-1,278)\ 20=45,100$ ft.-lbs.

and 124,120 ft.-lbs. for 10 secs. = 1,241,200 ft.-lb.-secs.
183,280 ft.-lbs. for 15 secs. = 2,749,200 ft.-lb.-secs.
45,100 ft.-lbs. for 5 secs. = 225,500 ft.-lb.-secs.

The sum of these numbers, 4,215,900, divided by the time per

run, 30 secs., and by 550, the number of ft.-lbs. per sec. in one horse-power, gives

$$\frac{4{,}215{,}900}{30 \times 550} = 256 \text{ horse-power.}$$

This is the average horse-power expended during the run.

Size of Motor.

The winding motor has to deal with a variable load, and the best method of obtaining its output is to take the root mean square of the torque during the run. It is this torque that determines the heating of the motor, and a motor calculated on this basis will give the same temperature rise as it would when running under a similar but uniform load.

$$HP = \sqrt{\frac{\text{Acc Torque}^2 \times T_{\text{Acc}} + \text{cons Torque}^2 \times T_{\text{cons}} + \text{Ret Torque}^2 \times T_{\text{Ret}}}{T}} \times \text{angular velocity.}$$

Substituting the foregoing numerical values we get—

$$HP = \sqrt{\frac{31030^2 \times 10 + 22910^2 \times 15 + 11275^2 \times 5}{30}} \times \text{angular velocity.}$$

Since the drum is 10 ft. diameter, its circumference is 31·4 ft., and to give a linear speed of 40 ft. per sec. to the rope it must make—

$$\frac{40}{31{\cdot}4} = 1{\cdot}27 \text{ revolutions per sec.}$$

One revolution $= 360$ degrees $= 2\,\pi$ radians.
Therefore the angular velocity in radians equals:

$$2 \times 3{\cdot}1416 \times 1{\cdot}27 = 7{\cdot}9.$$

The horse-power is therefore—

$$HP = \sqrt{\frac{31030^2 \times 10 + 22910^2 \times 15 + 11275^2 \times 5}{30}} \times 7{\cdot}9 = 348.$$

The excess of power over the average power expended during the run is due to the variable load and the necessity of dealing with the peak. Further calculation shows that during the last fraction of the last second of the acceleration period the motor is actually developing 450 horse-power.

In the case under consideration the motor would be coupled direct to the drum shaft. If deemed desirable, two motors, each of half the power, might be coupled one to each end of the drum shaft, so that in the event of the failure of one, the other would still be able to deal with the load at half speed. The chief point of such an arrangement as the latter is that it provides means of drawing the men should one motor fail, as simultaneous failure of both motors would be a most unlikely occurrence. There is, however, no more need for such a provision than there is for a second steam winder as a stand-by; besides, facilities for drawing men from the other shaft must be provided to satisfy the Mines Act.

At most collieries it is customary to raise and lower the men at a reduced speed; also rope inspection and shaft examination or repair necessitate the speed being reduced to a mere crawl. To meet these conditions the winding motor must be fitted with a controlling device of ample range and suitable capacity.

With such a winder the motor might be fed direct from the mains of a power company supplying a fair output, or it might be worked in conjunction with an equalising apparatus, whereby the peak load would be levelled, and the maximum demand on the supply mains diminished. There are several such systems, but the Ilgner is perhaps the best known. In this a motor-generator fitted with a heavy flywheel is installed. The motor side is fed from the general source of supply. The dynamo side is so constructed that the voltage can be varied between zero and the full amount allowed for in the design. This dynamo feeds the winding motor, which is necessarily of the D.C. type. During the acceleration period the winder makes a large demand on the motor-generator, and thus tends to increase the current taken by the motor side. The current taken from the mains is prevented from rising by means of a regulating device, and the dynamo side supplies the demand made upon it by drawing upon the stored-up energy of the rotating flywheel. This borrowed energy, together with that supplied by the motor side of the motor-generator, meets the demand of the winding motor at any moment. In the event of the load upon the winding motor being negative of zero, the whole output of the motor side of the motor-generator is stored in the flywheel, the current from the mains being prevented from falling off, as it has a tendency to do, by means of a suitable regulating device.

In the case under discussion the power diagram shows an average of 256 h.p. during the wind, and an expenditure of 4,215,900 ft.-lbs. during the 30 seconds occupied by the run. If this be equalised over the 45 seconds of a complete cycle, namely, runing and banking periods, we get

$$\frac{4215900}{45 \times 550} = 171 \text{ h.p.}$$

This 171 is the brake-horse-power that must be constantly furnished by the motor side of the motor-generator; therefore

$$256 - 171 = 85 \text{ h.p.}$$

has to be borrowed from and paid back to the flywheel during each wind.

If the motor-generator be fitted with a flywheel of 10 tons weight, revolving at 750 r.p.m., with a radius of gyration of 3 ft., then the kinetic energy K_1 stored in the wheel is

$$\frac{M V_1^2}{2\,G} \text{ ft.-lbs.}$$

where G = gravity
M = mass in lbs.
V_1 = velocity of a point at the mean radius in feet per second.

If now a demand for 85×33000 ft.-lbs. has to be supplied from the stored-up energy in the revolving wheel, the speed will fall to V_2 when the demand is completed, and the kinetic energy K_2 remaining in the wheel will be

$$\frac{M V_2^2}{2\,G} \text{ ft.-lbs.}$$

The flywheel therefore loses $K_1 - K_2$ ft.-lbs.

$$\text{or } \frac{M V_1^2}{2\,G} - \frac{M V_2^2}{2\,G} = \frac{M}{2\,G}\,(V_1^2 - V_2^2)$$

Therefore

$$V_1^2 - V_2^2 = \frac{2\,G}{M} W$$

where W is the ft.-lbs. of energy given up.

The revolutions per sec. equal

$$\frac{750}{60} = 12{\cdot}5$$

and with a mean radius of 3 ft. we get
$V_1 = 2 \times 3 \times 314 \times 12{\cdot}5 = 236$ ft. per sec.
$\therefore\ V_1^2 = 236 \times 236 = 55696.$

$$V_1^2 - V_2^2 = \frac{2\,G}{M} W = \frac{2 \times 32{\cdot}2}{2240 \times 10} \times 85 \times 33000 = 8064$$

Substituting the value of V_1, we have

$$55696 - V_2^2 = 8064$$

Therefore

$V_2 = \sqrt{55696 - 8064} = \sqrt{47632} = 214$ ft. per sec., and $236 - 214 = 22$ ft. per sec., or a speed fluctuation of about 10 per cent.

The chief advantages of a regenerative system such as that described lie in the equalised load thrown on the mains, and the ability to continue winding for several runs, using the stored-up energy in the flywheel should the main current fail.

In conclusion, it may be said that the employment of electricity for winding has now been perfected and placed on an assured basis, so that colliery owners need have no hesitation in adopting an electric winder when careful investigation shows that suitable conditions exist for its application.

ELECTRICAL MINING AND METALLURGICAL PATENTS PUBLISHED IN APRIL

Mining.

In Specification No. 3,841 of 1915, the Sterling Telephone and Electric Co., Ltd., F. G. Bell and H. W. Barclay describe an electrical signalling system for mines in which the signalling key is so constructed that upon a signal being complete, the key being restored to its normal position and a fresh signal started, the indicator is restored to its normal position, but upon sending distinct impulses of one signal without restoring the key to its normal position the indicator is not restored.

The same patentees have also a specification, No. 4,675 of 1915, describing a bell for mining signalling in which sparking at the trembler contact is reduced to a minimum by providing a short-circuited secondary winding wound on the core simultaneously with the actuating winding.

Improvements in miners' electric safety lamps form the subject of Specification No. 9,003 of 1915 of J. G. Patterson, which covers the provision of a lamp bulb having a standard socket piece provided with a pair of contacts arranged side by side and of different effective lengths by means of a steep pin engaging the opposite end of the lamp bulb.

Metallurgical.

Electric furnaces form the subject of Specification No. 13,951 of 1914, by H. Nathusius and the Westdeutsche Thomas-phosphatwerke Ges. The furnace in question has two or more sets of electrodes arranged symmetrically with regard to the heating chamber and presenting operating electrode surfaces in a plurality of zones round the heating chamber, and arranged so that the electrodes embrace the heating chamber along substantially its whole length, there being a flow of current between any two of the electrodes, the whole arrangement being such that the lines of current flow are caused to spread over the surface of the heating chamber and the charge.

ELECTRIC FURNACES AS APPLIED TO NON-FERROUS METALLURGY

A LONG Paper on the subject by Dr. Alfred Stansfield, of McGill University, was presented at the annual meeting of the Institute of Metals on March 29th. The author states that on account of the enormous size of the iron and steel trade, and the spectacular nature of recent developments in the production of steel, and even pig-iron, in the electric furnace, one is apt to overlook the fact that in value, if not in tons, the use of electric furnaces in non-ferrous metallurgy is greater than in the realm of iron and steel. In making this comparison he excludes from both sides the large production of ferro-silicon, chromium, tungsten, &c., which are partly ferrous and partly non-ferrous in character.

Electric furnaces are divided by Dr. Stansfield into two classes, according to the kind of operation for which they are to be employed, namely:—(a) Furnaces for the reduction of metals from their ores, and (b) furnaces for heating, melting, refining, and distilling metals. Class (a) includes electrolytic and electrothermic smelting furnaces. Class (b) covers heating furnaces, electric welding, soldering, and cutting appliances, and electric melting furnaces.

Electrolytic Furnaces.—These are used for the production of metals by electrolysis of their fused salts; aluminium, sodium, potassium, magnesium, calcium, barium, and strontium are produced largely, if not exclusively, in this manner, and other metals such as zinc are occasionally so obtained. Some metals cannot conveniently be produced electrothermally, and for these it is necessary to employ electrolysis. Such metals have so strong an affinity for oxygen that it is impossible to obtain them by electrolysis in aqueous solutions, and fused salts must be employed as electrolytes. It may therefore be said in general that electrolytic furnaces are used for the production of those metals that cannot conveniently be produced by thermal or electrothermal methods. The author proceeds to give a description of various processes for obtaining these metals.

Electrothermic Smelting Furnaces.—These are used for the production of metals from their ores with the aid of electrically-generated heat. The metal is occasionally present in the ore in the native or metallic state, when it merely needs melting to separate it from the gangue; but usually the metal is found as an oxide or other chemical compound from which it must be liberated by a chemical reaction involving the use of carbon or other reagent in addition to the necessary electrical heat.

Some metals (and semi-metals), such as silicon, chromium, tungsten, and titanium, require so high a temperature for their reduction or fusion that they can only be obtained (directly or indirectly) from the electric furnace. Some metals (like zinc) can be reduced by means of fuel heat, but only in externally fired retorts, as the products of combustion must be entirely excluded. For these metals electrical heat seems especially appropriate, as it can be produced within the charge to be heated, and there are no products of combustion. Another class of metals, such as copper, nickel, lead, tin, silver, and gold can be smelted readily by ordinary fuels, and for them the more costly electrical heat will only occasionally be employed.

Heating Furnaces.—These include electric muffles and similar furnaces for the heat-treatment of metals, enamelling, &c. They are usually intended for moderate temperatures, and in general are all resistance furnaces, being heated by solid resistances. The following types are mentioned: (1) tube and crucible furnaces heated by platinum wire, (2) furnaces heated by nichrome and other less expensive resistance wires, (3) carbon resistances for very high temperature work, (4) a furnace that has a resistance tube made of the same material as the filament of a Nernst lamp. This tube only becomes an electrical conductor when raised to a red heat, and is therefore heated, in the first place, by an external coil of nickel wire. This is also suitable for high-temperature work.

Electric Welding, Soldering, and Cutting Appliances.—These have not been used to any great extent in non-ferrous metallurgy, being far more applicable to the treatment of iron and steel. Pieces of metal can, however, be welded or melted together, either by passing a large electrical current across the joint, or by means of an arc between electrodes of carbon or of the metal to be treated. Bars of metal can also be cut by means of the electric arc. Electrically-heated soldering irons can be constructed and will prove very time-saving as compared with the ordinary variety.

In conclusion, the author points out that the most important application of the electric furnace to non-ferrous metallurgy is for the electrolytic production of metals, aluminium and sodium being the most notable examples. The electrothermic production of silicon, tungsten, chromium, vanadium, and many other metals is another important application of the electric furnace. There is no doubt a wide field for extension and improvement in this branch of electric furnace operation. The electric smelting of ordinary metals, such as lead, tin, zinc, copper, and antimony, has been taken up lately in view of the economies that should be obtainable in certain cases. Much work must still be done before the technique of these smelting processes can be perfected and before we can know how far the electric furnace can be effectively used in the production of these metals.

An important recent application of the electric furnace is for the melting and alloying of the non-ferrous metals. The practice has not yet become standardised, but there is certainly a great field for development in this direction. Lastly may be mentioned the use of electrical heating methods for annealing, welding, and many other minor metallurgical operations. Great improvements have been made in the design and construction of such furnaces, which will have an increasing use in the future.

TECHNICAL EDUCATION IN THE MINING INDUSTRY

A PRESIDENTIAL Address on the need for technical education in the mining industry, delivered by Mr. W. Stewart before the South Wales Institute of Engineers, is reported in the current issue of the Institute's *Proceedings*. Believing that this country will in the future, when the war is over, have to depend more upon its own resources than it has done in the past, and seeing that the more easily and cheaply worked seams in many of our collieries are becoming exhausted, and that more adverse natural conditions have to be faced, Mr. Stewart is convinced that our officials should have the best possible combined practical and technical training. He pointed to the rapid development of mining engineering. The South Wales & Monmouthshire Coalfield now has an annual output of over 50 million tons, and employs over 200,000 miners. The purely engineering side of the mining industry has developed to such an extent that many modern collieries are provided with electric power-producing plants equal in capacity to that of many large towns.

Mining engineering is a profession requiring for its future advancement the best brains of the youth of the nation, yet there are only about a hundred coal-mining students in this country, receiving a full-time day course of instruction for a period of three years. Reference was made to the establishment by colliery owners of mining schools at Treforest and Crumlin, where the Mining Board have arranged an apprenticeship scheme, assisted by scholarships, in the three branches of mining engineering, colliery engineering (mechanical and electrical), and chemical engineering.

It is essential, said Mr. Stewart, that colliery managers and other officials should interest themselves in the work of mining education, by granting facilities to students to attend mining classes, and encouraging them in every possible way to acquire the necessary practical experience in the various branches of underground work.

Unless technical instruction is supplemented by research work, we must continue to be dependent on the discoveries of other nations for any future advancement of the mining industry. Politicians are now beginning to realise that technical education and research work are vitally important for the welfare of the nation; but unless the owners of large industries, like the mining industry, take steps to provide their own means of research, and facilities for applying the results on a commercial scale, little progress need be expected for some years to come.

Association of Mining Electrical Engineers.—The following officers have been elected for the 1916–17 session of the Yorkshire branch of the Association of Mining Electrical Engineers:—President, Roslyn Holiday (Ackton Hall Colliery); Vice-Presidents, Messrs. A. L. Flint (H.M. Assistant Inspector of Mines) and F. Marsland (Barrow Colliery); Joint Hon. Secretaries, Messrs. J. A. McLay and H. Elliot.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"Alternating Currents." By H. R. Kempe. 83 pp. 7½ in. by 4¾ in. 25 figures. (London: Crosby Lockwood and Son.) 3s. 6d. net; abroad, 3s. 9d.

"Directory of Paper Makers of the United Kingdom, 1916." 236 pp. 10¾ in. by 7¼ in. (London: Marchant Singer and Co.) 1s. net; by post, 1s. 5d.; abroad, 1s. 8d.

THE ARC FURNACE AS A CENTRAL STATION LOAD

At first sight an electric arc furnace would appear to be a load quite unsuitable for operation from a central station supply. Short-circuits are liable to occur at any moment during certain stages of the melting, and, in addition to this, the normal variation in load may be some 30 per cent. above and below normal rating. In a recent issue we gave some interesting details of a Nathusius steel furnace installation at the works of the Sosnowicer Röhrenwalzwerke u. Eisenwerke A.G., where this difficulty had been largely overcome (see ELECTRICAL ENGINEERING, April 6th, p. 120). It appears that there has been in successful operation for the past twelve months a Heroult 1-ton furnace in the works of the Lebanon, Pa., Steel Foundry. Energy for this furnace has been supplied under contract by the Edison Electric Illuminating Co., of Lebanon, Pa., whose electrical engineer, Mr. Harry Hollis, gives in the *Electrical World* some particulars of the installation.

The mechanical operation of the furnace is taken care of by a small motor-generator set supplying direct current to three motors controlling electrode feed and a small motor driving the "Thury" regulator. A three-phase motor of the slip-ring type is used to tilt furnace in pouring a heat. The motor-generator set and all transformers are located in a fire-proof compartment so that the furnace operators do not come in contact with any high potential. The transformer room is kept locked with a danger sign fixed on the door. The energy is generated by the central station at a pressure of 2,400 volts, three-phase, 60 cycles, and the furnace load is taken from the same busbars that supply a mixed load used for lighting, industrial power, and tramway. The tramway load is carried by a 500-kw. rotary converter. The generating units include one 1,250-kw. and one 500-kw. turbo-generator. The average demand during the winter months, between the hours of 7 a.m. and 11 p.m., is about 1,000 kw. at 80 per cent. power factor, the 1,250 kw. set carrying the load except over the lighting peak, when the 500 kw. unit is operated.

The 2,400-volt feeder consists of three No. 0000 wires mounted on a wooden cross arm with a mean distance between wires of 24 in. The length of line is 1·08 miles. The feeder panel at the generating plant is equipped with an overload trip, operated through an inverse-time-limit relay set for 200 amp. (800 kva. at normal potential), and trips in eight seconds at this setting.

The receiver panel at the foundry end is located in the transformer room, and is equipped with three single-pole, disconnecting switches. The instruments consist of a polyphase, graphic, power-factor indicator and a polyphase, recording, watt-hour meter. The energy is measured and sold as primary power. From the receiver panel the primary wires pass through an oil switch operated from the furnace-control panel. The switch has an overload trip operated through an inverse-time-limit relay set to operate with 91 amp. in six seconds; that is, with 362 kw. at normal potential, the furnace being rated at 225 kva. at 92 per cent. power factor. The three single-phase transformers are rated at 75 kva. each, with primary wound for 1,330Δ–2,300Y volts and the secondary for 90–110 volts. The primaries are Y-connected to the primary mains. The secondaries are connected delta and, as operated, give 110 volts. The three electrodes of the furnace are connected to the 110-volt secondaries by means of two 500,000-circ. mil. cables in parallel.

The character of the furnace load is that of a three-phase electric arc without a steadying resistance or reactance in series with the same. The furnace when starting a heat picks the arc without making a short-circuit by having coke placed on the scrap metal directly under each electrode. After the three arcs are started the first thirty to forty minutes are generally free from short-circuits. At the end of that time the electrodes have melted holes in the scrap metal a little larger than themselves, and into these the electrodes feed. The iron therefore begins to fall in along the sides of the holes into which the electrode extends, causing short-circuits which operate an automatic oil switch on the control panel. If the operator immediately raises the three electrodes and places coke into these holes the furnace can be started again, but if this is not done the breaker is liable to trip out as often as the operator puts it in. Other short-circuits are caused after the greater part of the charge is in a molten state by the operator pushing into the bath solid pieces of the unmelted metal lying along the sides of the furnace. After the charge is all melted, the slag formed on the molten metal by lime tends to prevent short-circuit. The load varies continually during the heat, due to change of resistance of the arc, these variations averaging 30 per cent. above and below normal load. Short-circuits sufficient to operate the breaker five or six times each heat of three and one-half hours occur, and must be considered as characteristic of the electric-arc furnace melting cold scrap. These must be limited to the capacity of the generating system.

The effect of a short-circuit on the regulation, both as to frequency and voltage, of an electric-generating system depends on the magnitude and time element of short-circuits and the regulating characteristics of prime movers. The speed regulation of the prime movers is of considerable importance, and especially so when equipped with direct-connected exciters, as any sudden change of speed, due to heavy loads being thrown on and off, gives the automatic voltage regulator double duty. A practical method to limit the short-circuit current to a value that will not cause disturbances in the generating system is secured by means of reactances.

It is the experience of the supply company that the electric-arc furnace is a desirable business, giving a balanced three-phase load of high power factor and load factor, and that it can be successfully operated from a central station of moderate capacity. That the service has been satisfactory is attested by the fact that the Edison Electric Illuminating Company recently closed a contract to supply current to an additional furnace of 2-ton capacity at the foundry which has operated the 1-ton furnace for the past twelve months.

In any case the short-circuit current of the furnace feeder should be limited to a definite value by means of reactance. On the new 2-ton installation transformers having a reactance drop of 10 per cent. are specified by the company.

It is of great importance to the steel mill, as well as to the central station supplying energy to operate furnaces, that all electrical equipment of the furnace be inspected at definite intervals by a competent electrician. The steel plant already referred to employs a capable engineer, who spends about three or four hours weekly going over the equipment. This is all the expert attention required during the twelve months' operation.

ELECTRICAL CHARGING WAGGONS FOR COKE-OVENS

Until recently, coke-ovens were universally charged by hand with small tip-waggons or by overhead cable-ways, requiring a large number of workers, both at the ovens and at the coal-bins. In some more modern plants the charging is done by means of large electrically-driven waggons, each holding a complete charge of from 8 to 12 tons, but this system has not in the past been applied to existing plants as the ovens themselves are not generally easily adapted to it. The oven walls must be strong enough to bear the weight of the loaded waggon (18 to 25 tons), and the waggons are so wide that it is necessary that the condensers for recovering the tar, &c., should be placed at the side instead of at the top of the furnace.

Recently, however, this system has been applied with success to existing coke-oven plants, with very little reconstruction of the furnace structure and waggon track, by adopting small waggons. Some interesting details of one such installation are given in the German mining journal *Glückauf*. This installation comprises a battery of sixty coke-ovens, which are kept charged by one man instead of the ten or twelve required by the old method. The coal-bins are not in a direct line with the axis of the track over the charging hoppers, but the small waggons can take curves down to 5 metres radius. The charging set comprises three waggons of about three tons capacity each. Each waggon is 4 metres long by 1·2 metres wide and 1·7 metres high, and is divided into two parts with the usual drop bottoms. Between the two hoppers is the driving motor of 4 kw. capacity, which together with the starting and other switchgear is enclosed in a dust-proof compartment. Power is taken from an overhead trolley-wire, and the motor is controlled by a lever. After the three waggons have been filled under the coal-bins, they are sent along in succession under their own power towards the ovens, the operator following on the last. When the waggons reach the coke-oven platform their motors are switched off automatically, and the brakes applied by means of stops projecting up from the track. These stops are placed by the operator at the particular oven it is desired to charge. The waggons are brought into the correct position and emptied by the operator, who then sends them back on their own power and returns himself on the last, after having closed the top of the filled oven and moved the stops to the next oven to be filled.

ANNUAL REPORT OF THE INSTITUTION OF ELECTRICAL ENGINEERS

THE council's report for the session 1915–16 has now been published, and will be submitted to the annual general meeting on May 11th.

A slight shrinkage is reported in the total membership, which is now 6,676, as against 6,817 a year ago.

THE INSTITUTION AND THE WAR.

The following distinctions have been awarded to members of various classes during the year :—

Companion of the Bath.—Col. J. C. Chambers, A.S.C.

Distinguished Service Order.—Major F. J. Chapple, R.G.A.; Major S. H. Cowan, R.E.; Capt. A. E. Davidson, R.E.; Capt. H. M. Leaf, R.M.L.I..

Victoria Cross.—Lt.-Com. E. G. Robinson, R.N.

Military Cross.—2nd Lieut. C. H. Goulden, R.G.A.; Lieut. H. R. L. Groom, Royal Warwickshire Regt.; Lieut. H. J. Gwyther, Manchester Regt.; Capt. H. P. T. Lefroy, R.E.; Lieut. I. W. Massie, R.E.; Lieut. A. Podmore, R.E.; 2nd Lt. O. W. Sherwell, R.F.A.; Lieut. A. C. Sparks, R.E.; Lieut. A. R. Tabor, R.F.A.

Distinguished Service Cross.—Lieut. E. G. Boissier, R.N.D.

Distinguished Conduct Medal.—Pte. A. M. Doig, Manchester Regt.; Cpl. C. W. Saunders, New Zealand Eng.; Pte. P. J. Wood, London Regt.

Distinguished Service Medal.—Sapper J. H. Murray, R.N.D.

Mentioned in Dispatches.—Major A. S. Angwin, R.E.; Lieut. C. R. Bicknell, R.G.A.; Capt. H. Carey-Thomas, R.E.; Capt. W. Casson, London Regt.; Commander W. H. Cottrell, R.N.V.R.; Sapper E. L. Damant, R.N.D.; Lieut. H. L. Downes, Liverpool Regt.; Lieut. C. H. W. Edmonds, R.E.; Major L. Evans, R.E.; Petty Officer C. S. Hann, R.N.D.; Lieut. L. V. Hart, R.E.; Major F. A. Iles, R.E.; Major G. S. Knox, R.E.; Capt. H. P. T. Lefroy, R.E.; Lieut. R. K. Morcom, R.N.D.; Capt. G. T. W. Olver, R.E.; Capt. T. V. Smith, R.F.C.; Major G. H. Spittle, R.N.D.; Capt. R. E. Stace, R.E.; Brig.-Gen. A. M. Stuart, C.B., Director of Works; Lieut. H. R. Tuppen, A.S.C.; 2nd Lt. R. A. Williams, R.E.

The following have been killed in action or died of wounds, &c., during the year :—

Killed in Action.—Lieut. A. R. Alderson, R.E.; Lieut. A. W. Brydon, Queen's Royal West Surrey Regt.; 2nd Lt. H. G. Byng, Border Regt.; Capt. W. Casson, London Regt.; 2nd Lt. H. J. G. Davison, Lancashire Fusiliers; 2nd Lt. J. Forbes, R.E.; Major A. Gardiner, R.E.; 2nd Lt. S. Gudgeon, Manchester Regt.; Sub-Lt. W. J. Henry, R.N.D.; Sgt. E. Hoyle, H.A.C.; Tpr. F. E. Hunt, Sussex Yeomanry; Pte. N. V. Lloyd, Manchester Regt.; Lance-Corpl. C. W. Miller, Manchester Regt.; Capt. V. W. Newman, Loyal North Lancs. Regt.; Pte. E. C. H. Slater, Manchester Regt.; Lieut. J. M. Thornton, R.E.; Capt. E. G. Tidd, Highland L.I.; 2nd Lt. A. Y. Young, Royal Scots Fus.

Died of Wounds.—Sergt. G. S. Bradbury, Manchester Regt.; Pte. A. M. Doig, Manchester Regt.; 2nd Lt. G. H. Eardley-Wilmot, Machine Gun Corps; Pte. J. Gilbert, Manchester Regt.; Pte. C. H. Hill, Canadian Infantry; Corpl. R. P. Hulton, R.N.D.; Sapper A. H. Ogden, R.N.D.; Lance-Corpl. A. H. Read, R.N.D.; 2nd Lt. E. Swinton, R.F.A.; Sapper F. E. Tilley, R.N.D.; Sapper P. A. E. Warburton, N.Z.Eng.; 2nd Lt. W. Winkworth, Northumberland Fus.

Died.—Pte. T. Duesbury, Royal Berkshire Regt.; Trumpeter N. V. Foote, Australian Light Horse; Col. G. P. Seligmann-Lui, French Military Telegraphs; Sapper H. Woodside, R.N.D.

The total number of members serving or having served in the Forces is given as over 1,300. The council have under consideration a scheme to facilitate employment of disabled sailors and soldiers after the war. The Engineering Institutions Volunteer Training Corps, founded largely under the auspices of the Institution, consists of about 120 men.

MEETINGS.

During the year 12 ordinary meetings have been held in London and 39 of the Home Local Sections, as well as meetings at Calcutta, Cape Town, and Hong Kong. The formation of the proposed Canadian Section has been postponed, due to the war. Seven students' meetings have been held in London and two in the provinces.

PREMIUMS.

The following premiums have been awarded for papers read :—

The Institution Premium (£25), J. R. Beard; *The Fahie Premium* (£10), H. H. Harrison; *The John Hopkinson Premium* (£10), Prof. A. B. Field; *The Paris Premium* (£10), N. W. Storer; *An Extra Premium* (5), A. Campbell and D. W. Dye; *An Extra Premium* (£5), A. E. Clayton; *An Extra Premium* (£5), Professor G. W. O. Howe.

The usual scholarships have not been awarded.

Wiring Rules.—The new revised edition of the Wiring Rules which was published in March has now been adopted by the whole of the Fire Insurance Companies of the United Kingdom, and have been accepted as standard practice by the Incorporated Association of Electric Power Companies, the Incorporated Municipal Electrical Association, the whole of the Electricity Supply Companies of London, and by the principal Supply Companies in the provinces.

Research.—It is recorded that Government grants of £340 for research on the heating of buried cables, and of £250 for research on the properties of insulating oils have been made, and that further grants are under consideration.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

One of the most useful Papers read before the Institution of Post Office Electrical Engineers was presented by Mr. B. S. Cohen, on April 17th. It described the work he has been doing on "Telephonometry," a new name the meaning of which is obvious. The telephone engineer has the choice of two methods for measuring transmission efficiency, namely, the use of artificially produced alternating currents of various high frequencies and their measurement, or actual voice tests through a standard cable. The latter gives the more reliable results, but it is a laborious one, and Mr. Cohen has devoted much work to the development of a "telephonometer," chiefly for the purpose of making reception tests of apparatus delivered in quantities. A wave containing the majority of the frequencies of telephonic importance is produced by an interrupter, which is varied in speed through a complete cycle of frequency progress from 700 to 1300 cycles per sec. and back again. An electro-magnetic receiver is employed with no resonance points in this range of frequency. To take the place of the ear a sensitive moving-coil galvanometer is used, connected through its shunt to a carbon rectifier, which is at the centre of one winding of a 1 : 1-transformer. The other winding is connected through one or more audion gas discharge relays and thence to the high winding of a 1 : 5-step-up coil, the low side of which is joined to the standard cable. With the rhythmic transmitter described, and a steady deflection is obtained on the galvanometer. The results obtained agreed very closely with those given by speech tests, and the time taken for the test is but a small fraction of that required by the speech method.

Portsmouth now possesses one of the most up-to-date telephone systems in the country. At 2 o'clock last Saturday afternoon three local exchanges in the town were changed over to the automatic system. The installation of this system, the equipment for which has been provided by the Automatic Telephone Manufacturing Co., Liverpool, has been proceeding for several months, and the change over was accomplished in a few minutes, practically without interruption to the service. About 5,000 lines were involved in the change to the new system, which at present is arranged for a maximum of 9,999 lines, but is capable of extension practically without limit. Of these 5,000 there are 3,600 direct subscribers, 1,000 two-party, 200 four-party, and 200 private branch exchanges. On Saturday 3,356 lines were transferred simultaneously to the automatic system. The three local exchanges involved are the ex-National Telephone Exchange, having 1,841 lines with 2,674 stations; the Municipal Exchange, with 1,471 lines—1,827 stations; and the North End Exchange, with 44 lines having 47 stations. The change has necessitated a rearrangement of subscribers' numbers, and conseqeuntly the issue of a new directory. The method of operation is fairly simple, being as follows :—Assume it is required to ring up 5509. First remove the receiver and place the tip of the finger in the hole over the 5 and press the dial round to the stop. Then release and allow it to swing back. Re-insert the finger in the 5 hole again and repeat the operation, and so on with the 0 and the 9. As soon as the last figure is "dialled," the bell of the subscriber rings and communication is at once established. If the number is engaged, the usual intermittent buzzing noise is heard. If it is desired to ring up the Exchange or make trunk calls, one has to dial "0," and is then put through manually in the ordinary way. Elaborate provision is made for the detection of faults, which are automatically recorded at the exchanges by either visual or audible signals, and a fault may frequently be remedied before it is detected by the subscriber concerned.

THE INSTITUTION AND ITS GERMAN MEMBERS

Result of the Ballot

THE result of the ballot of the members of the Institution of Electrical Engineers as to the method in which enemy members are to be dealt with has now been published. The taking of this ballot was decided upon as the result of two meetings of the members of the Institution in London, one of which at least was of a very stormy character. Full reports of these meetings were published in ELECTRICAL ENGINEERING for March 9th, page 82, and March 16th, page 95. We give the result of the ballot below :—

Number of cards issued	3,244
Number of cards returned	1,470

Proposal.	In favour of the proposal.	Against the proposal.
(*a*) To expel members who are subjects of enemy countries or States	1,320	88
(*b*) To expel members who, being naturalised British subjects have retained enemy nationality ...	1,307	79
(*c*) *Not* to expel members who are naturalised British subjects and were formerly subjects of a country or State now at war with Great Britain and Ireland, but who have under the laws of such country or State definitely lost their alien nationality, provided they are able to prove this to the complete satisfaction of the Council	1,081	264
(*d*) That no person shall after the —— day of ——, 19—, be eligible for election as a member of the Institution who is a subject of any country or State with which the United Kingdom of Great Britain and Ireland is or shall have been at war on or after the date mentioned	1,120	200

A resolution has been drafted to carry out the objects proposed, and has been submitted to two Counsel. The opinion of one Counsel has been received, and as soon as the second is available the necessary meetings of the Corporate Members will be called.

AN EVERLASTING PRIMARY CELL

DR. FRIEDRICH ALEXANDER JUST, of Budapest (whose name is best known in this country in connection with the Just-Hannaman process for the manufacture of metallic filament lamps), has discovered a new primary cell absolutely different from any previously known. He is reported to have made the following statement to a representative of the *Pester Lloyd* :—"The action of the cell is based on an entirely new physical phenomenon. It contains no liquid, neither is it constructed in the manner of the known dry cells. The electrodes can be of cheap material, such as carbon and iron, and with one pair of carbon-iron electrodes it is possible to obtain any voltage up to about 35 volts with a corresponding current. The cell does not need recharging nor the addition of fresh material, but regenerates itself by absorbing oxygen from the air. The cost of construction is extraordinary low. It has not yet been discovered how the cell really works, and, indeed, it seems to act contrary to the law of the conservation of energy. We are carefully studying the problem, and endeavouring to find the source of the energy given out, but the very mystery and importance of the discovery prevents me from stating anything further. A number of patents have already been applied for to protect our interests as far as possible. It would appear that the new cell will not only supersede all present primary cells, but will also compete successfully with the lead accumulator, and might even come into competition with power-driven generators for some purposes. For military purposes it will be especially useful, as it can be set up anywhere in a very short time. A large Austro-Hungarian firm will be entrusted with the manufacture of the cell."

Very shortly after the publication of the above, Dr. Just discovered that he had been hoaxed badly by one of his assistants, who had connected the new carbon-iron cell to a hidden battery of the "superseded" type.

THE PROTECTIONIST POLICY OF THE B.E.A.M.A.

IT was bound to come that Free Trade *v.* Protection should cease to be a political question, or, to be more accurate, we should say a question of party politics. Once freed from their party-political ties and from their obligations to follow fixed principles and doctrines and to adhere to party labels, it became almost a certainty that manufacturers must almost without exception support a Protectionist policy. The British Electrical and Allied Manufacturers' Association has boldly stated its opinions in the following resolution passed unanimously by the Council, and published in the April number of the quarterly *B.E.A.M.A. Journal* :—

"That the Government should, as soon as possible, proceed to formulate a tariff scheme, embodying :—

"(1) An Imperial Customs Union between Great Britain and her overseas Colonies, Dominions, and Dependencies, with a view to the adoption at some later period of free trade within the British Empire.

"(2) A tariff on all goods imported into this country which are such as can be efficiently and economically manufactured in British workshops.

"(3) That a substantial preference should be given to all goods, whether manufactured or otherwise, imported from any portion of our overseas Empire.

"(4) That a smaller preference than the foregoing should be given to those countries which are now allied with us in defending the right of national existence against the dominating influence of the Central European Powers.

"(5) That such preference as may be possible, having in view the balance of trade between nations, be given to neutral countries.

"(6) That the duty imposed on goods of Austrian and German manufacture should be of a highly protective character, not only in Great Britain, but also in the overseas parts of the Empire."

The above resolutions appear in an article by Mr. Frank Broadbent relating the assistance given by the B.E.A.M.A. to the Board of Trade Committee on Trade after the War. References to the report of this Committee and to the work of the B.E.A.M.A. in connection with it has already appeared in ELECTRICAL ENGINEERING (Feb. 10, p. 49).

War Tribunals.—An employee of the South London Electric Supply Corporation last week applied for exemption on the ground that he was in a reserved occupation, in that he was employed on public utility service. It was explained to the Tribunal that electric lighting companies are in the list of exempt occupations and have not yet been removed from it. The question was adjourned for inquiry, the Chairman of the Tribunal complaining that such cases should be brought before the Tribunals.—At Blackpool, Mr. Charles Furness, the borough electrical engineer and tramway manager, applied for exemption for three single men, mechanics in the service of the Corporation and who are also employed on Government work making shells. Some rather strong opinions were expressed by one or two members of the Tribunal that any single men should be employed in this way, but eventually the cases were adjourned for a fortnight in order to enable Mr. Furness to make application for badges for the men and to communicate the result to the Tribunal. —One fitter employed by the Imperial Tramway Co., at Stockton, has been exempted until August, but in the case of another the appeal was disallowed. In both cases the application was on the ground of indispensability, it being pointed out how important it is to maintain the car services, seeing that the Company carries 6,000 munition workers daily.—Six months' conditional exemption has been granted to a lecturer in physics and electricity at the Brighton Technical College. The case on his behalf put forward by the Brighton Education Committee was that the man is engaged on work of more national importance than his services in the Army would be.—The Richmond Tribunal has refused to exempt the assistant in the showroom of the Richmond Electric Light & Power Co. The claim of the manager that this employee was in a starred occupation was denied by the military representative.—At Kingston-on-Thames an electrician in the employ of a firm of engineers engaged on building contracts for the Admiralty was granted exemption until July 31st, the Admiralty requesting that this course should be taken in order that the work in question might be completed as quickly as possible.—Exemption until July 31st has also been granted in the case of the manager and secretary of the Dawlish Electric Light Co., the Company meanwhile to endeavour to get a substitute.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,493.

I have charge of several electric passenger lifts on D.C. 400 volts with direct-coupled motors running at about 750 r.p.m. On three of the lifts there are so-called dynamic brakes, the armatures being shorted through a portion of the starting resistance when the current is switched off, the shunt currents being also broken through kicking coils; in two cases the shunts are broken on one pole only, in the other case on both. One motor is compound, the series being cut out after starting, the other two are plain shunt. The controllers are by different makers, but act in practically the same way, the shorting switches being on the tails of the up and down switches, which are solenoid controlled. The motors start up on the first step, and everything is in good order. The point is that the dynamic brakes are not a bit of use, and the full duty of stopping comes on the mechanical brakes. What is best to be done? The field coils cannot be left in circuit, as they overheat. Each controller has three solenoids, one for resistances and one each for the up and down switches.—BRAKE.

(Replies must be received not later than first post, Thursday, May 11th.)

ANSWERS TO No. 1,491.

If a three-phase turbo-alternator is short-circuited at its terminals when running, a very large current will flow, the amount of which depends chiefly on the inductance of the stator winding. If full particulars of the machine are known, is it possible to determine approximately the value of the instantaneous short-circuit current? If so, please state clearly the method of doing it. How long could the short be left on without damaging the alternator, and what is the maximum value of the current which would not damage the stator winding?—B. M. S.

The first award (10s.) is made to "E. H." for the following reply:—

The instantaneous value of the current produced when a fully-excited turbo-alternator is suddenly short-circuited depends upon many factors, some of which are uncertain and variable, so that it is practically impossible to calculate its magnitude. If the exciting current of a short-circuited alternator be increased gradually to its normal value, the stator current does not rise to more than 2½ or 3 times the full-load value on account of the demagnetising action of the stator current, which is then lagging almost 90° behind its E.M.F. On the other hand, when a fully-excited alternator running at its rated speed is suddenly shorted, the instantaneous value of the current may attain to 20, or even 30, times the full-load current. In this case the machine does not have time to become demagnetised; in fact, the sudden increase in the current tends to alter the flux in the poles, causing eddy currents to be induced in the latter (or in the field winding if the poles are laminated), and the direction of these eddy currents—by Lenz's law—is such as to try and prevent any change in the flux. Consequently the demagnetising action of the stator current can only increase as these eddy currents decrease. If the latter were absent, the instantaneous value of the short-circuit current would be determined mainly by the inductance of the windings due to the magnetic flux leaking across the armature slots and around the end-connections. This inductance can be calculated with a fair degree of accuracy, but it accounts for only about a half of the apparent inductance as determined by experiment, the remainder being due to the inductance of the paths of the eddy currents in the poles, and it is this portion that is practically impossible of calculation. From oscillograph records, Prof. Miles Walker (*I.E.E. Journal*, Vol. 45) estimated that the current of a certain 5,500-kw. three-phase generator rose at the instant of short-circuit to 32 times its full-load value; and after one second it was still 50 per cent. greater than the steady short-circuit current, which was about three times the full-load current.

The time for which a short-circuit current can be left without damaging the alternator (assuming the latter to have withstood the stresses at the instant of short-circuit) depends mainly upon the heating time-constant of the stator winding. For a turbo-generator this is roughly about one hour; this means that if there were no loss of heat, the permissible temperature rise of the windings under full-load conditions would be attained in one hour. If the steady short-circuit current be assumed three times the full-load current, the rate of generation of heat in the windings is increased ninefold, so that if no heat were lost the permissible temperature rise would be reached in 60/9=say, 7 minutes. In such a short time the amount of heat dissipated would certainly not be great, but, at the same time, the iron losses in the surrounding iron would be decreased, due to the demagnetising action of the armature current. It would therefore be probably safe to leave the short-circuit current on for about 10 minutes.

As regards the maximum value of the short-circuit current that will not damage the stator winding, this again is very difficult to estimate, since it depends upon the decrease in the iron losses brought about by the reduction in the flux, upon the nature and thickness of the insulation between the copper and the iron core, and upon the facility with which heat is dissipated from the end-windings. It must be remembered that the increase in the I^2R loss due to the short-circuit current produces more or less a local heating effect, and the temperature rise is limited, not by the stator as a whole, but by the insulation in the immediate vicinity of the copper. The lower the iron losses and the thinner the insulation, the greater the amount of heat dissipated from the winding through the medium of the core, and therefore the greater is the increase in the permissible stator current; but in the absence of any data it is impossible to estimate the latter. It may be stated that conditions of short-circuit are to be avoided except where it is required to dry out a machine; the current is then adjusted so that the stator windings are at about 170° F.

No second award is made.

Electro-chemical Industries in South Africa.—An important report has been issued by the Development of Resources Committee of the South African Institute of Electrical Engineers, on the possibilities of establishing in South Africa on a commercial basis certain electro-chemical industries. The report, says the *Board of Trade Journal*, does not attempt to cover the whole subject, but is confined to South Africa's chief industries, agriculture and mining. These industries taken together now require annually more than £2,000,000 worth of chemicals, all of which are imported in the form of fertilisers, cyanides, and nitrates. The essential elements for the successful manufacture of the compounds are cheap electricity, abundant coal and limestone, and all these, together with the necessary labour, are available in South Africa. Furthermore, the local market is to a considerable extent protected from competition by the necessarily high cost of transport for imported articles, as well as by Customs duties. The report considers the prospects of producing calcium carbide and cyanide and derivatives of cyanide, and the conclusion is arrived at that these products can be profitably manufactured in South Africa, provided the necessary raw materials are available at reasonable cost. It is therefore urged that an early investigation should be undertaken with regard to the location, quality, and cost of production of these raw materials.

The Croydon Tramway Strike.—The tramway employees of the Croydon Corporation, following the example of their brethren employed by the South Metropolitan Electric Tramways & Lighting Co., have returned to work, notwithstanding the Corporation has not rescinded its resolution refusing to refer to arbitration the grievances as to hours and conditions.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published April 27th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

3,364/15. **Insulators.** W. E. W. Richards. Moulded cement insulators, &c., in which the cement is impregnated with a soluble pitch-like residuum.

5,200/15. **Relays.** E. T. Ruthven-Murray and G. F. Shotter. Relays with an exciting coil surrounding a pivotted armature, in which the current necessary to cause the armature to be attracted is adjusted by varying the air gap separating the armature from a fixed or adjustable yoke. (Three figures.)

5,200/15. **Load Equalisation.** B. T.-H. Co., N. Shuttleworth, and G. M. Brown. Control of flywheel motor-generators driven by induction motors by automatic regulation of a series type commutator machine connected in cascade with the induction motor, so that the excitation of the commutator machine is comparatively weak between no load and the predetermined load, and thereafter increases rapidly with further additions of load. This regulation is obtained by diverting current from the series exciting windings through a variable reactance adapted to increase in value automatically by a variable air-gap, or otherwise, and diverting less current the higher the load. (Five figures.)

5,741/15. **Discharge Tubes.** B.T.-H. Co. (*G.E. Co., U.S.A.*). Electric discharge apparatus having an incandescent cathode in which the region of the cathode liable to erosion is protected by a negatively charged conductor interposed between it and the anode. (Five figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables, &c.: G. S. Boothroyd and Callender's Cable & Construction Co. [Cable clamps] 603/16 (*100,233*).

Dynamos, Motors and Transformers: De Ferranti and Ferranti, Ltd. [Transformers] 7,826/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Rotary converters] 7,987/15.

Heating and Cooking: Elmen, Salisbury, and Talbot [Water heaters] 9,584/15.

Ignition: Cadett and Percy [Magnétos] 5,168/15; Codd [Magnetos] 11,033/15.

Switchgear, Fuses, and Fittings: Hochstadter [Protective system] 22,045/14; Murray and Shotter [Circuit-breakers, &c.] 5,201/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Rectifiers] 5,557/15; Landis & Gyr A.G. [Short time switch] 6,991/15; Robinson [Fuse carriers] 8,546/15

Telephony and Telegraphy: Potts [Telegraph instruments] 1,997/15 and 4,402/16 (*100,239*); Marks (*Delany Foreign Co.*) [Telegraph system] 2,163/15; Savin & Automatic Telephone Mfg. Co. [Telephone relays] 5,596/15; Marconi's Wireless Telegraph Co. and Franklin [Aerials] 5,783/15; Roberts [Amplifiers] 10,272/15; Turner [Telephone systems] 18,084/15.

Miscellaneous: Patterson [Electric miners' lamps] 5,323/15; Siemens & Halske A.G. [Alarms] 5,623/15; Elliott and Solectric Co. [Portable primary cells] 5,731/15; De Ferranti, Roothaan, and Ferranti, Ltd. [Apparatus employing oil insulation] 7,827/15; Brown [Vibrating make and break device for signalling] 7,840/15; F. Krupp A.G. [Remote control apparatus] 12,614/15.

The following Specification is open to Inspection at the Patent Office before Acceptance, but is not yet published for sale.

Electric Heating: J. E. Harvey [Circuit breakers for heaters] 4,703/16 (*100,252*).

Suspension of Enemy Patents

9,499/12 and 13,903/13. **X-ray Apparatus.** Siemens & Halske A.G. Applications to avoid or suspend these patents, both of which deal with a system involving a revolving commutator for the supply of H.T. current to X-ray tubes, by Watson & Sons (Electromedical), Ltd., will be heard on May 10th.

26,297/04, 21,750/09, 24,389/10, 19,473/11, 16,165/12, 218/13, 1,179/13 and 25,180/13. **Rail Welding.** Goldschmidt. The applications of the British Thermit Co., Ltd., regarding these patents have resulted in licences being granted. They all relate to rail welding by the Thermit process.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Incandescent Lamps: R. Griffiths [Candle lamps] 1,070/07.

Instruments and Meters: B.T.-H. Co. and A. J. Martin [Meters] 1,115/06; A. E. G. [Meters] 660/08.

Switchgear, Fuses and Fittings: W. Fairweather (*Benjamin Electric Mnf. Co.*) [Wireless cluster fittings] 689/06 and 620/08; W. D. Kilroy and Evershed & Vignoles [Automatic starters] 793/07; W. G. Childs and T. S. Hill [Lift control] 1,086/09.

THE ELECTRIC VEHICLE COMMITTEE

A MEETING of the Electric Vehicle Committee was held in London on April 14th, Mr. R. A. Chattock presiding. It was announced that all the Associations, with the exception of the Tramway and Light Railways Association, whose reply had not been received, had re-nominated their representatives on the Committee. The Committee re-elected the representatives of the following:—Provincial Electric Supply Companies, Makers of Electric Vehicles, Edison Accumulators, Ltd., Chelsea Electricity Supply Co., Ltd. It was decided to invite the Society of Motor Manufacturers and Traders to nominate a representative to sit upon the Committee.

The present officers of the Committee were re-elected for the present year, except Mr. A. H. Seabrook, Hon. Editor of the Journal, who, by reason of the work he is engaged upon in connection with munitions supply in London, is unable to devote any time to the work connected with the Journal. This work the Hon. Secretary is undertaking *pro tem.* until someone can be found who will accept the position.

It was decided that, in future, dimensions for standards will be given in both metric and British measures, and that, in regard to the British measures, exact dimensions will be quoted in mils, while ordinary dimensions will be quoted in fractions. The Secretary was instructed to bring this rule to bear in quoting dimensions of standards in the Annual Report of the Committee.

Mr. E. W. Curtis, of the General Vehicle Co., was nominated as the Committee's representative upon the Tyre and Road Wear Research Committee of the Society of Motor Manufacturers and Traders.

NEW COMPANIES

COATES & CO. (Sheffield), 345 Glossop Road, Sheffield. Capital £3,000. To take over the existing electrical engineer's business at the above address.

MAKIN & CO., 39 Townhead Street, Sheffield. Capital £1,000. To adopt an agreement with Makin & Co., electrical engineers, now in voluntary liquidation.

SCOTT ELECTRICAL CO., National Provincial Bank Chambers, Queen's Square, Wolverhampton. Capital £100,000. To adopt an agreement with the Efandem Co., Ltd., and Jesse Varley. Manufacturers of, and dealers in, lighting sets, lamps, dynamos, and all classes of electrical apparatus for motor vehicles, airships, aeroplanes, &c.

CONNER MAGNETO AND IGNITION CO., 71A Queen Victoria Street, E.C. Capital £52,000. To adopt agreements with the Peel-Conner Telephone Works, Ltd., and M. S. Conner, and to deal in magnetos for motor-cars, motor-cycles, aeroplanes, etc., as well as electric lighting and starting appliances. The first directors include H. Hirst and M. S. Conner.

PHONOPORE CONSTRUCTION CO., LTD., 53–57 Park Street, Southwark, S.E. Capital £4,175 in 4,000 ordinary shares of £1 each, and 3,500 founder's shares of 1s. each. To enter into an agreement with Mr. Justus Eck and to manufacture telephonic and phonoporic instruments. Mr. Justus Eck is Chairman, and the New Phonopore Telephone Co., Ltd., may be represented on the Board by two directors during the continuance of a lease referred to in an agreement dated January 17th, 1916.

NEW SHADE CARRIER

A VERY ingenious and neat device for fixing shades, which we illustrate below, is being placed on the market by Siemens Bros. Dynamo Works, Ltd. (38 Upper Thames Street, E.C.). It is designated the "Easy-Clip" and is said to be suitable for use wherever shade carrier rings have previously been employed. It has two sets of claw grips, the inner to engage the screwed part of the lamp-holder, and the outer to grip the shade. Both are under spring tension, so that the clip

"EASY-CLIP" SHADE CARRIER.

can be readily inserted in the shade after compression. The inner claw grip is brought to a standard tension when fixed in the shade, and the claws firmly engage the thread of the holder when it is forced through the grip. It therefore reduces shade fixing to two simple operations, and completely dispenses with the use of a shade carrier ring. The shade is removed by unscrewing, and it is not possible to remove the shade by any other method, because the grip on the holder and on the shade are in opposite directions.

LOCAL NOTES

Edinburgh: *Increased Charges.*—The charge for electricity for lighting purposes is to be increased by $\frac{1}{2}$d. per unit, making the charge $3\frac{1}{2}$d. per unit, whilst the charge for power supply where no contract is in existence is to be increased by 5 per cent.

Grimsby: *Difficulties with Plant.*—The acting engineer, Mr. A. S. Channon, reporting upon the position as regards plant in the power-house, states that for some time after the war, unless additional plant is arranged for in advance, it will be necessary to continue the existing restrictions upon supply. The Committee is following the policy of refusing to connect new consumers, but the acting engineer holds the opinion that a scheme of extensions should be put in hand at once, so that the necessary plant may be ordered immediately conditions alter, so as to involve the least possible inconvenience. The Committee has adopted the engineer's report, and in the event of the war being over by next winter has agreed to continue the restrictions both as to private and public lighting.

Huddersfield: *Certification of Electricity Works.*—The Minister of Munitions is to be asked to issue a certificate to the effect that the Corporation electricity works comes within the Munitions of War Act.

Electricity Charges.—The discount scales for lighting and power are to be cancelled. In future, agreements for three-phase current are to be fixed for periods of three years.

London: *Marylebone: Wages Dispute.*—The Electricity Department has been having trouble in connection with the wages of the members of the "running staff," many of whom have joined the National Amalgamated Union of Enginemen, Firemen, Mechanics, Motormen, and Electrical Workers. Last July negotiations took place between the Union and the Department, with the result that the wages of certain sub-station attendants, dynamo and water attendants, and firemen were increased by $\frac{1}{2}$d. per hour, but before the close of the year a demand for an immediate advance of 4s. per week for all men employed at the generating station or sub-stations was made. To this the Borough Council objected, and eventually the matter went to the arbitration of the Committee on Production. On April 17th this Committee gave its award in favour of the Borough Council.

Mansfield: *The I.M.E.A. Meeting.*—The Electricity Committee has decided not to send representatives to attend the annual meeting of the I.M.E.A. this year.

Salford: *Bulk Supply.*—The Electricity Committee recommends a modification of the terms upon which the Lancashire Electric Power Co. now supplies electricity in bulk. At present the Company has to have ready at demand 2,000 kw., but the Electricity Committee is agreeable that this amount should not be always on demand unless the Company have the necessary plant available, and that when this maximum is likely to be required the Corporation should give the Company reasonable notice.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Greenock.—The Corporation has decided to apply for power to borrow £45,000 for the Electricity Department.

Nelson.—A turbo-generator set is required.

Wiring

Bridlington.—The Alexandra Hotel is to be extended by the addition of 300 bedrooms.

Huddersfield.—Plans for extensive buildings for British Dyes, Ltd., have been approved.

Swansea.—Sanction has been given for the borrowing of £5,000 for the erection and equipment of a small-pox hospital.

APPOINTMENTS AND PERSONAL NOTES

Mr. Percy Priestley, Chief Engineer and Manager to the Mexboro' & Swinton Tramways Co., has been recommended for the post of General Manager of the Oldham Corporation Tramways.

A shift engineer is wanted at Canterbury Electricity Works. (See an advertisement on another page.)

A man is wanted to take charge of plant. (See an advertisement on another page.)

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £144 to £146 (last week, £139 to £141).

"Quead" Electric Fires.—Messrs. Ikin and Eads (47 to 57 Marylebone Lane, Oxford Street, W.), the makers of "Quead" electric fires, advise us that from May 1st there will be 20 per cent. advance on list prices. The firm have an assorted stock of these fires ready for immediate delivery.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Willans and Robinson.—There was a net profit of £16,726 in 1915, after making provision for depreciation and allowances for employees on active service. A dividend of 10 per cent. is recommended on the Ordinary shares, leaving £8,776, of which it is proposed to carry £7,099 to the Reserve Fund and to distribute the balance among the holders of "B" stock and Ordinary shares as provided by the articles. The Queen's Ferry Works have at last been sold.

Johnson and Phillips.—After charging to revenue about £9,000 for maintenance of buildings, plant, &c., the profit for 1915 was £69,084. After bringing in the balance of £24,296 from the previous year and deducting the interim dividend already paid, a further dividend of 5 per cent. per annum is recommended, after allocating £12,148 to depreciation. At the annual meeting last week, Mr. R. W. Blackwell, who presided, expressed the opinion that the Company had neither been advantaged nor injured financially by the war to any special extent. A large portion of the considerable amount of new plant that had been installed to meet Government requirements would be of real utility to the Company later on, and on the whole there was good reason to be satisfied with both the present position and prospects of the Company.

Metropolitan Electric Supply Co.—As previously reported in our columns, the annual general meeting of the Metropolitan Electric Supply Co. was adjourned until May 2nd in order that the Shareholders' Committee might present a report of its investigations. The Committee, however, were not in a position to report on Tuesday and the meeting has been adjourned until such later date as the Committee may agree.

TRADES DIRECTORY OF
ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Poulton Bros., Ltd., 38 and 39, Cowcross St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

FLEXIBLE METALLIC TUBING.
United Flexible Metallic Tubing Co., Ltd., 112, Queen Vict. St., E.C.

HEATING AND COOKING APPARATUS.
Belling & Co., Derby Rd., Edmonton, N.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
The Bastian Elect. Heating Syndicate, Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Record Electrical Co., Ltd., Caxton House, Westminster, S.W.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Phœnix House, King William St., E.C.

LADDERS.
Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 66, Victoria St., S.W.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

LAMPS (Incandescent)—*contd.*
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Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

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METERS.
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British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

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Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

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Peebles (Bruce) & Co., Ltd., Edinburgh.
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Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

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Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
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Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
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Igranic Electric Co., Ltd., 147, Queen Victoria St., E.C.
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TECHNICAL BOOKS.
Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
Constable (Archibald) & Co., Ltd., 10, Orange St., Haymarket, W.
Crosby Lockwood & Son, 7, Stationers' Hall Court, E.C.
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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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SUMMARY

THE effect of the adoption of the Daylight Saving Scheme and the circular of the Board of Trade urging electric supply authorities to reduce their consumption of coal by 10 per cent. upon electric supply undertakings is discussed in an article on p. 168.

AN electric furnace, said to be the first in the United States installed for the sole purpose of producing steel castings as a commercial product, is in operation at the Treadwell Engineering Co., of Easton, Pa. It has a capacity of 6 to 8 tons per day (p. 168).

IN a discourse at the Royal Institution last Friday, Sir J. Mackenzie Davidson described various means for locating bullets and pieces of shell which had become embedded in the human body. Precautions necessary in observations by X-Rays were described, and the use of the stereoscope in this connection was illustrated (p. 168).

A PAPER on "High voltage D.C. railway practice," by Mr. C. Renshaw, was read before the American Institute of Electrical Engineers on April 14th. The paper deals with the fundamental differences in apparatus for 1,200 or 1,500 volts as compared with the former 600-volt standards. It is argued that final standards in voltage are fixed by economical considerations rather than by physical limitations, and 5,000 volts is suggested as a convenient high-voltage standard (p. 169).

A FURTHER list of promotions, transfers, etc., and members of the Institution of Electrical Engineers serving with His Majesty's Forces is published (p. 170).

AN article in an American contemporary by the Chief Electrical Engineer of the New York Edison Co. describes in detail a method of jointing 25,000-volt lead-covered cables which has met with considerable success (p. 170).

AMONG the subjects of patent specifications published last Thursday are telegraphy. current limiters, rectifiers, wireless telegraphy and transformers. An appeal has been lodged against the grant of an approved patent for heating apparatus. A lapsed patent for telephone receivers has been restored. A crane control patent expires this week after a full life of 14 years (p. 172).

AN automatic stereoscopic method of locating bullets in a body, developed by Prof. A. Hasselwander and successfully used in Germany, is described (p. 174).

A large quantity of lamps are required in Australia; telegraph material in Canada; a steam tramway is to be converted to electric traction in New Zealand; an extension scheme, estimated to cost £60,000, is contemplated at Rochdale; motors are required at Manchester; and plant at Wigan and Bo'ness (p. 174).

SOME of the provincial Electricity Committees have decided not to send delegates to the I.M.E.A. this year. —A satisfactory year's progress is recorded at Rotherham.—The Edinburgh Electricity Committee is to contribute to the sinking fund on a 30 years' basis instead of 25 years in order to avoid a deficit of £17,000 this year (p. 175).

OWING to an unfortunate postal delay we are unable to publish our Questions and Answers' page this week.

Arrangements for the Week.—*(To-day), Thursday, May 11th.* —Institution of Electrical Engineers. Annual general meeting, 8 p.m.

Monday, May 15th.—Royal Society of Arts. Lecture III., on "Vibrations, Waves, and Resonance," by Dr. J. Erskine Murray.

ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEER CORPS

IN consequence of the desire of General Sir O'Moore Creagh, this Corps has now joined with the 4th Battalion Central London Regiment (Architects Corps), under the command of Lt.-Col. C. B. Clay, V.D. The identity of the Corps will be preserved in the Engineering Institutions Company, and the funds will remain separate.

1st LONDON ENGINEER VOLUNTEERS

LATE 4TH BATTALION CENTRAL LONDON REGIMENT VOLUNTEERS. ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

The amalgamation of the 4th Batt. Central London Regiment Volunteers and the Engineering Institutions Volunteer Engineer Corps having been ordered by the County Commandant, the Corps will in future be known as the 1st London Engineer Volunteers.

Thurs., May 11th.—Instructional parade.

Entrenching Parade, Tues., May 14th, at Victoria (S.E. & C. Ry. Booking Office), at 9 a.m. Uniforms, haversacks, and water bottles. Mid-day rations to be carried. Railway vouchers will be provided. As Major-Gen. Sir Francis Lloyd, K.C.B., will inspect the Corps at work, *every member should make special efforts to attend.*

The parade for Richmond Park on Sunday, May 21st, is cancelled.

Special Orders, No. 3 Company.—Drills, 6.25, 7.25, 8.25.

Thurs., May 11th.—Shooting for Secs. 3 and 4. Recruits, 5.45—7.45.

Fri., May 12th.—Secs. 3 and 4, Technical; 1 and 2 Squad and Platoon, Signalling Class and Recruits.

Sat., May 13th.—Co.-Commander Flemings' Instruction Class, 2.30.

Sections for Technical, parade at Headquarters, London Electrical Engineers, 46 Regency Street, S.W. Sections for Shooting, parade at miniature range. Unless otherwise stated all parades at Chester House.

Engineering Industry in the Economic War.—Under the auspices of the Institution of Engineers and Shipbuilders in Scotland, the West of Scotland Iron and Steel Institute, and the Glasgow Chamber of Commerce, Mr. T. C. Elder, on behalf of the B.E.A.M.A., will deliver an address on this subject at the Royal Technical College, Glasgow, on Tuesday next, May 16th, at 2.15 p.m. The Lord Provost of Scotland will preside.

DAYLIGHT SAVING AND LIGHTING ECONOMY

ELECTRIC supply undertakings, especially those depending for a large portion of their revenue upon the lighting load, will not view without some misgivings the possibilities of the near future with regard to further restrictions upon artificial lighting. Coincidently with the Government discussion of the desirability of adopting the daylight saving scheme, which has formed the subject of controversy for so many years, has come a request from the Board of Trade to electric lighting and gas undertakings to restrict their consumption of coal to the extent of 10 per cent. in order to free a larger quantity of coal for export purposes. The letter in question is in the following terms:—

I am directed by the Board of Trade to state that, as you will be aware, difficulties have been experienced for some time in securing adequate supplies of coal for manufacturers of munitions and other consumers of national importance, owing to the decline in the output of coal from the mines and the increase in demand for war purposes. The position has been met in the past to a large extent by restriction of export; but coal which is now being exported goes largely to meet the urgent requirements of our Allies, or is valuable as a weapon in negotiating with neutral countries.

The Board have observed with some concern a recent decline in coal exports, and in their opinion it has become necessary that special steps should be taken to maintain and, if possible, to increase the exportable surplus of coal, and that for this purpose everything possible should be done to encourage economy in the use of fuel at the present time. A copy of the notice which they recently issued recommending a reduction in the consumption of domestic coal is enclosed for your information.

The question has been further considered by the Central Coal and Coke Supplies Committee, and they have recommended that a general policy of economy in lighting should be adopted, and that gas and electric lighting undertakings should be asked to do what they can to reduce the consumption by a definite amount. The Board think there can be little doubt that there are many cases in which light is at present being used needlessly or wasted altogether. They have, accordingly, decided to request owners of gas and electric lighting undertakings that they should notify their consumers that the Government desire to see the consumption of coal for lighting purposes reduced by 10 per cent., and they should do all in their power by notices and inspection to see this recommendation carried out. The Board would suggest that inspectors be sent round as often as possible to examine meters and hand to consumers where necessary a notice reminding them of the recommendation, and calling attention to the fact that they have not yet carried it out. The Board would be glad to be informed of the steps taken.

Translated into terms of £ s. d., of course, this means that consumers will have to be asked to reduce their consumption of current, and this, coming on top of the reduction in the amount of artificial light made use of as the result of the economy which abnormal times are forcing upon many users, will undoubtedly have a serious effect on many balance-sheets at the end of the year.

As was anticipated from the trend of discussion during the past week or so, the Government on Monday decided to adopt the principle of daylight saving, and a Bill is to be introduced for this purpose, it being anticipated that the change will take effect as from Sunday, May 21st. Huge figures have been quoted as to the economy in artificial lighting bills which will be effected by the adoption of the scheme which the late Mr. William Willett pressed unsuccessfully upon the House of Commons for so many years, but whether—at any rate, for some time—the people of this country will adjust their habits at the other end of the day to bring about this economy is, at any rate, a little doubtful. That there will be considerable savings, of course, is undoubted, and any uneasiness which has been engendered in the minds of electric supply undertakings it has been endeavoured to brush away by the reservation that the measure is one for the period of the war only, and that the whole matter will receive further consideration then.

COMMERCIAL PRODUCTION OF STEEL CASTINGS BY ELECTRIC FURNACE

AN electric furnace plant, which is said to be the first one installed in the United States for the sole purpose of producing steel castings as a commercial product, is described in a recent issue of the *Electrical Review and Western Electrician* by Mr. W. J. Kyle. The furnace was designed and built by the Treadwell Engineering Co., of Easton, Pa., at whose works it was put into operation on August 14th, 1911. It is an arc furnace of the Héroult type, with a capacity of two tons per heat, and it can make three to four heats per day of twenty-four hours.

The electric energy is alternating, three-phase, 60-cycle, and delivered to the plant at 11,000 volts. It is transformed for use in the furnace to about 80 to 85 volts, 2,500 amperes. The raw material used in the furnace consists of about equal quantities of heads and gates from castings of previous heats and steel scrap purchased in the open market. The furnace is basic lined with magnesite brick.

The reactions in the furnace are all very similar to that in the basic open hearth, with the exception of the period of deoxidation. Once the charge is melted, an oxidation or refining by oxidation takes place, which results in the removal of the carbon, manganese, silicon, and phosphorous, together with a small part of the sulphur. The slag formed in this first period is removed by tilting the furnace. Charcoal is then added for re-carbonising, together with lime, fluorspar, and ferro-silicon, to produce the deoxidising and desulphuring slag. Ferro-manganese and ferro-silicon are added to the bath to give proper contents of manganese and silicon. The current is turned off, and the furnace tilted to an angle of 45° from the horizontal and the contents teemed into a pouring ladle, from which the castings are either poured directly or by means of small ladles and shanks.

With the electric furnace it is possible to remove all but traces of phosphorus and sulphur, but this is not general practice.

The analyses given below are typical of steel entering into castings:—

Silicon	0·44	0·58	0·29	0·44	0·29
Manganese	0·48	0·22	0·43	0·58	0·66
Phosphorus	0·017	0·015	0·023	0·022	0·017
Sulphur	0·012	0·014	0·015	0·015	0·012
Carbon	0·22	0·11	0·19	0·19	0·21

The low phosphorus and sulphur is rather noteworthy, in view of the fact that no special care is required in the selection of the raw material. The carbon is purposely maintained low to ensure the easy machining of and ductility in the castings.

The following physical tests are in every way characteristic of the steel produced by electric furnace. The carbon ranges from 0·16 to 00·23 per cent.

TESTS OF UNANNEALED STEEL.

Maximum Strength. Pounds per Square Inch.	Elastic Limit. Pounds per Square Inch.	Reduction of Area, per cent.	Per cent. elongation in 2 inches.
66,500	36,000	43·8	28·0
66,300	36,200	48·9	31·5
65,800	44,900	51·0	29·5
Three following tests are of the same bars when annealed:—			
70,500	56,200	24·0	21·5
71,400	52,000	40·8	25·0
66,800	50,000	34·2	27·0

Detection of Bullets by X-Rays.—In a discourse on "Electrical Methods in Surgical Advance" at the Royal Institution on Friday last, Sir J. Mackenzie Davidson described methods of locating bullets and fragments of shell in the human body. He showed that simple photographs taken by X-rays might be very deceptive; two such photographs were shown of a case in which a bullet lay on the front of the breast-bone, and of these one showed the bullet apparently in the left lung, and the other apparently in the right lung. This difficulty might be overcome by the use of the stereoscope, a very useful instrument of which the value in the past had been overlooked. He instanced the case of an officer who, after examination by X-rays, had been operated upon in Belgium for the extraction of a bullet from the arm near the shoulder; the officer was told, however, that the bullet was embedded in the bone and could not be removed. He afterwards came into hospital in this country, where investigation proved that the bullet was not in the arm at all, but in the body near the arm-pit (having passed through the arm), and it was removed by a simple operation. The lecturer showed slides illustrating various forms of operating couch arranged for direct examination of embedded bullets by X-rays, in which the bullet was located by two direct observations from slightly different positions and one or two simple measurements. He also showed a pair of forceps which were attached in an electrical circuit in such a way that when a bullet came between them the variation in resistance of the circuit caused sounds in a telephone attached in the circuit and worn by the operator. Small pieces of shell were frequently detected by a large A.C. electromagnet, which the lecturer showed, the alternations of the magnetic field causing the foreign bodies to vibrate, and these vibrations could be felt by the hand placed on the surface of the skin. The magnet shown was operated at 200 volts, 50 frequency, and took 30 amps. Its weight was balanced by a counterpoise over a pulley.

HIGH TENSION D.C. RAILWAY PRACTICE

THE desirability of establishing a standard high voltage for use in the electrification of railways on the continuous-current system has been discussed during the past session at the Institution of Electrical Engineers. It is interesting to find that a similar discussion has been taking place at the American Institute in connection with a paper on high-voltage D.C. railway practice, read at New York by Mr. C. Renshaw on April 14th. In this paper the author argues that final standards in voltage are usually fixed by broad economic considerations rather than by physical limitations, and he suggests 5,000 volts as a suitable high-voltage standard. He mentions some of the problems which present themselves even with high-voltage equipment which is now fairly well standardised in America. For instance, should the voltage be 1,200 or 1,500? should the equipment be of the dynamotor compressor or the non-dynamotor type? will it have to operate on high voltage only or on both high and low voltage? if required to operate on low voltage as well as high, will half-speed be sufficient on main and compressor motors, or will full speed on both voltages be necessary? must the change-over switch be arranged for indirect control or will manual operation be sufficient? if indirect control is required, can it be confined to the individual cars or will simultaneous operation throughout the train be required? is a protective device essential to guard against damage by the application of the wrong voltage, or will this not be required? Other similar questions might be added to the list, but these are the most important ones.

Where the high-voltage cars must run over existing 600-volt lines to any considerable extent, the exact ratio between 600 and 1,200 volts offers some advantages. Since high-voltage motors are made from existing standards also, there is a wider range of choice for 1,200-volt operation than there is for 1,500 volts, especially where small sizes of motors are required. So far, 1,500 volts has been used in sections where 600-volt lines have been established only to a limited extent, while 1,200 volts has been employed in sections where there has already been considerable 600-volt development. It seems probable that high-voltage practice will continue to follow these lines except in the case of the electrification of branch lines on steam railroads, or similar instances where connections with existing lines will have little bearing. Speaking broadly, the general tendency is toward the use of the dynamotor compressor on large expensive cars, particularly where full speed is required on half voltage, since this arrangement lends itself readily to such operation. Dynamotor compressors also are particularly suitable for locomotives where forced ventilation is utilised. For smaller and less expensive rolling stock, non-dynamotor outfits are generally employed, although there is, and always will be, a certain amount of overlapping.

In the older sections of the country, where distances of four or five miles must sometimes be run on city tracks, and where through cars over 600-volt lines are likely to be employed, equipments are usually required to operate at full speed on half voltage. Equipments for operating at half speed under these circumstances, however, offer considerable advantage in weight, cost, and general simplicity, and will undoubtedly find a considerable field where circumstances are favourable to their use. Where large cars are arranged for full speed on both voltages, the tendency is toward the use of full speed for the air compressor also. On smaller cars, where as a rule the compressor has more margin, half speed of this device is ordinarily thought sufficient, even where the main motors operate at full speed.

With regard to power supply, an early step in the production of high-voltage D.C. power was the use of two 600-volt, 25-cycle synchronous converters connected in series, and while this was considered a radical step at the time it was first proposed, the performance obtained was so satisfactory that single 25-cycle converters producing 1,200 or 1,500 volts on one commutator have now been developed and are in successful use. With 60 cycles, the maximum voltage so far employed from a single machine is 750, so that two machines in series are still required for high-voltage lines. The performance on this basis, however, is most excellent. Common substation practice for high-voltage D.C. lines is now to employ single synchronous converters where power at 25 cycles is available, and to use either motor-generator sets or two converters in series, where 60-cycle power is employed. A particularly efficient substation arrangement on the latter basis is secured by installing three synchronous converters so arranged that any two of them may be connected in series. This gives a spare machine at a minimum expense. If a single bank of three transformers is used for supplying these converters, a spare transformer as well as a spare converter is also secured, so that the station is prepared for almost any emergency.

In studying the development of 1,200- and 1,500-volt practice, the fundamental point is the ease, success, and speed with which so radical a departure from previous practice has been carried out. In most developments of so far-reaching a nature, many sources of difficulty are usually overlooked at first, and must be cared for in later apparatus at increased expense. In the high-voltage D.C. railway system, however, just the opposite has apparently happened. Many of the possible difficulties seem to have been overestimated in importance, and much of the trouble anticipated has failed to appear. It has therefore been possible to gradually simplify and cheapen the various fundamental parts which go to make up the system instead of having to follow the opposite and more usual procedure.

The general results of the high-voltage D.C. system have been to make possible the construction of inter-urban lines or the electrification of branch steam railroad lines at considerably less expense for a given grade of construction than with 600 volts, or to render possible for a given expenditure the construction of lines capable of handling much heavier traffic. The usual practice has apparently been a compromise between these two possibilities, which has served to finally transfer the electric line from the street car to the real railroad class as far as transportation possibilities are concerned, while still maintaining the relationship and similarity with reference to the simplicity and reliability of the apparatus. With practically no greater expenditure for substations and feeders than the usual 600-volt trolley line, such roads are able to employ freight or passenger trains after the manner of steam lines in accordance with the needs of their business instead of having to restrict them on account of limitations in the distribution of power.

The general construction of the 5,000-volt experimental equipment on the Grass Lake line of the Michigan United Traction Co, and the results of its first few months' operation have been widely covered by the technical Press, and it is unnecessary to refer further to them except to say that the equipment is still in operation on the same successful basis, and that at the time this is written it has run a little over 30,000 miles. During the five months from October 1st to March 1st, the car averaged 5,295 miles per month on a schedule which allows only 15 miles per hour, and its record would have been even greater than this had it not been for numerous mechanical difficulties with the trucks, wheels, brake rigging, stove, pilots, and other mechanical parts of the car for which the equipment was in no way responsible. During the four months of November, December, January, and February, which, on account of weather conditions, are ordinarily considered the worst in the year, the car ran 23,320 miles, or an average of 5,830 per month. During this period the car operated through severe snow, sleet, and rain storms, and for a short period even ran with two of the commutator covers missing, these having been lost on the road. The motors and control were purposely allowed to go with a minimum of cleaning and other care, and various reports sent in by the men in charge refer to the presence of wheel wash, dirt, and other obnoxious substances in the motors and switch groups, although no damage was caused by them.

A half-dozen or so failures have occurred during the winter, but these have been mostly in the nature of broken motor leads or similar troubles, which served merely to test the practicability of the use of such a voltage under the general rough conditions to which car equipments are subjected rather than to indicate any inherent weakness. These troubles showed that this equipment could as easily withstand such ordinary mishaps as any equipment for 600 volts. Only two of the failures were in any way due to the use of 5,000 volts, and these consisted of grounds on the grid resistance which took place through the water-soaked, flame-proof covering on certain of the leads where the cables had not been properly insulated and supported. Such troubles can be easily guarded against on new equipments. While as yet only the one equipment now in experimental operation has been built, various designs of other sizes have been considered, and with the special double armature type of motor and double-jaw type of switch which have made this equipment possible, unusual flexibility in meeting a wide range of conditions can apparently be obtained.

In most of the considerations of the use of D.C. voltages of 2,400 and 3,000, there has always been a certain minimum size of motor which could be economically produced, and this size has been undesirably large for certain classes

of service. With the special double-armature type of motor for 5,000-volt equipments, however, the experimental equipment already in use is about as small as would ordinarily be required, although even this is apparently not the minimum limit. On the other hand, the design seems equally adaptable to large sizes.

In concluding his paper, Mr. Renshaw said that, broadly viewing the high-voltage D.C. practice which we find to-day and its significance to the industry, there were four ideas which appealed particularly to him. The pernicious flexibility of the 1,200- and 1,500-volt systems and the innumerable alternatives which they present for application to any definite case in inter-urban work seem to give timely warning of the great desirability of early standardisation in the matter of higher D.C. voltages. The comparative ease with which apparatus for these voltages has been developed gives a most encouraging feeling for further development along the same lines. The possibilities which a D.C. system at 5,000 volts would offer, were the apparatus commercially available make this voltage seem a logical one, and the results obtained with the experimental equipment now in operation give great hope that this voltage may some day be established commercially as a standard of high-voltage D.C. railway practice.

THE INSTITUTION AND THE FORCES

THE following is a further list of promotions, transfers, &c., of members of the Institution of Electrical Engineers serving with the Forces. The previous list was given in our issue of April 20th, p. 140.

Members.—Capt. J. Caldwell, A. and S.H.; Major D. S. Capper, Warwickshire Regt.; Capt. W. L. Carter, R.E.; Capt. S. B. Haslam, Welsh Regt.; Lieut. W. H. U. Marshall, Dorset (Fortress) R.E.; 2nd Lieut. F. C. Raphael, London Elec. Eng., R.E.

Associate Members.—2nd Lieut. A. J. Anido, London Elec. En., R.E.; Lieut. R. G. Beer, R.E.; 2nd Lieut. L. C. F. Bellamy, R.E.; Capt. H. K. Benson, Glamorgan (Fortress) R.E.; Capt. M. G. Bland, London Elec. Eng., R.E.; C. A. Brearley, Divisional Engineers, R.N.D.; Capt. W. W. Buckton, R.E.; 2nd Lieut. B. E. Bumpus, Northumberland Fusiliers; 2nd Lieut. F. L. Cater, A.S.C.; Sergeant H. Church, Essex (Fortress) R.E.; 2nd Lieut. L. H. Davies, R.G.A.; Lieut. A. E. H. Dinham-Peren, R.E.; Capt. M. I. W. Ellis, Cheshire Brigade, R.F.A.; Capt. T. Ellis, A. and S.H.; Sergeant A. W. Empson, Motor Machine Gun Service; Major G. G. Ewer, Essex Regt.; 2nd Lieut. J. S. Gibson, Royal Sussex Regt.; Lieut. C. H. Goulden, R.G.A.; Major C. B. Grace, Kent (Fortress) R.E.; Flight Sub-Lieut. C. H. Hayward, R.N.A.S.; Lieut. J. G. Jones, Royal Fusiliers; Major H. P. T. Lefroy, R.E.; 2nd Lieut. W. R. Lewis, R.F.C.; Lieut. J. A. Manners-Smith, R.G.A.; 2nd Lieut. L. C. Martin, East Anglian R.G.A.; Major F. H. Masters, London Electrical Engineers, R.E.; Eng. Lieut. F. G. Matravers, R.N.; Lieut. G. D. Nelson, R.N.A.S.; Sergeant L. Owen, Provisional Battalion; Lieut. J. H. Palmer, Royal Fusiliers; Capt. F. G. Payne, Lincolnshire Regt.; Lieut. C. Powell, Lowland Divisional R.E.; Capt. F. D. Pyne, R.E.; 2nd Lieut. H. K. Reed, London Elec. Eng., R.E.; Lieut. T. N. Riley, Divisional Engineers, R.N.D.; Capt. J. A. Rutherford, Machine Gun Corps; 2nd Lieut. C. W. Salt, London Elec. Eng., R.E.; 2nd Lieut. T. A. Smith, R.E.; Capt. G. S. Taylor, Northumberland Fusiliers; Major H. W. Tyler, Kent (Fortress) R.E.; Capt. F. R. Unwin, London Divisional R.E.; Lieut.-Col. H. W. Watts, East Surrey Regt.; Capt. R. H. Whittington, Royal Fusiliers; Capt. G. W. Williamson, R.F.C.; 2nd Corpl. A. E. G. Wood, Divisional Engineers, R.N.D.

Associates.—Major T. C. Cunningham, R.G.A.; Capt. R. G. Madge, London Elec. Eng., R.E.; Capt. Sir H. Norman, Bart., Ministry of Munitions; Major L. S. Simpson, R.E.; 2nd Lieut. W. S. Tucker, General List.

Graduates.—W. S. Browne, London Elec. Eng., R.E.; Lieut. F. E. Burnett, East Riding (Fortress) R.E.; Capt. Sir J. A. C. Campbell, Bart., Scottish Horse; Capt. H. W. Curling, A.S.C.; Capt. J. H. D. Sheppard, A.O.D.; 2nd Lieut. C. Vandermin, Royal Fusiliers.

Students.—Sergeant E. C. Albrecht, R.E.; Lieut. S. G. Anderson, R.E.; J. T. Bedford, Royal Monmouth R.E.; Lieut. T. B. Berry, R.E.; 2nd Lieut. R. G. Burton, London Elec. Eng., R.E.; S. A. B. Campbell, Hussars; 2nd Lieut. H. S. Cuerdon, A.S.C.; Flight Lieut. G. G. Dawson, R.N.A.S.; Capt. M. R. de Cordova, A.S.C.; Lieut. H. A. Denison, K.R.R.; Lieut. F. C. W. Dixon, Oxford and Bucks Light Infantry; Sergt.-Major J. W. Elliott, R.E.; Capt. R. Fruhe-Sutcliffe, Provisional Field Co., R.E.; 2nd Lieut. J. A. Gibson, R.F.C.; 2nd. Lieut. A. M. Jenkins, London Elec. Eng., R.E.; 2nd Lieut. W. H. Lovell, Grenadier Guards; Lieut. R. W. Macklin, R.G.A.; 2nd Lieut. R. C. Philipp, R.E.; 2nd Lieut. S. M. Rawson, Royal Fusiliers; Lieut. J. B. Snell, R.E.; Sub-Lieut. C. J. H. Trutch, R.N.A.S.; 2nd Lieut. H. A. Voss, London Elec. Eng., R.E.; J. R. A. Willey, Northamptonshire Regt.

HIGH VOLTAGE CABLE JOINTS

THE results of experience in the construction of cable joints for pressures up to 25,000 volts are contained in an interesting article in the *Electrical World* by Mr. P. Torchio (Chief Electrical Engineer to the New York Edison Co.). The earlier forms of E.H.T. cable joint, made with insulating fibrous tapes or tubes and hard compound fillers, although satisfactory up to 13,000 volts, gave trouble on higher voltages. Extensive experiments were carried out by the author's company with different joint-filling compounds without much success. The chief difficulty found with liquid fillers was that they ran into the cable and left voids in the joint. This difficulty, however, was completely overcome by a design of joint briefly described as follows:—

The cable splice is hand-wrapped with oil-saturated paper tape, insulating oil being brushed all over the surface of each layer. In a similar manner over the three conductors, properly spaced and packed with a saturated filler, is wrapped an outer jacket, which is then pierced at several points so that the oil will freely enter the interior of this jacket. Over the jacket is applied copper gauze, and around it a heavy lamp-wick. The object of the metal gauze is to provide a continuous metallic cover around the solid insulation to protect the latter against electrostatic charges, even if some of the oil leaves the joint, and still allow the oil free access through the holes of the gauze. The lamp-wick is applied to retain by surface tension the insulating oil in the splice, even if the oil should leave the annular space between the insulation and the lead jacket. The latter is made somewhat larger than usual to hold an extra amount of insulating oil to feed the lamp-wick. After the joint is completed it is subjected, by means of a vacuum pump, to a vacuum of about 27 in. to 29 in., and then filled with a liquid compound. To supply any oil absorbed by the joint and the cable connected to it, a special pressure cup full of oil is applied and left connected for twenty-four hours, after which time the cup is removed and the hole capped and sealed.

Splices of this type are being used on three 25,000-volt underground-cable transmission lines. Under laboratory test they have withstood without failure 50,000 volts, three-phase, for over 340 hours, when the test was discontinued. Out of more than thirty experimental splices of all types, the oil-filled ones were the only ones which withstood indefinitely the 50,000-volt, three-phase test. Some of these splices were tested with equally satisfactory results, even when drained of all the oil in the annular space between the joint and the lead sleeve.

The joints referred to were made with three conductor 350,000 circ. mil. paper-insulated, lead-covered, sector-type cable. The insulation round each conductor was 8·5/32 in. thick, and the insulating belt 4/32 in.

Before preparing the cables for splicing they were carefully aligned; 8·5 in. of the lead sheath was then stripped off the ends, the belt insulation removed except for 1·25 in. next to the lead, and 1·125 in. of insulation cut off the end of each conductor at right angles thereto, with a special tool. The ends of the lead were then belled, as this operation cannot be performed so easily after the conductors are soldered; and to prevent accumulation of dirt and penetration of moisture, the space between the belled lead and the insulation was packed with insulating compound and wrapped with clean cheesecloth, which was allowed to lap over the armour. Split connectors, 2 in. long, chamfered 0·5 in. on each end to remove sharp edges (which would cause static discharge), were then fitted over the ends of abutting conductors and soldered. All metal points were then removed by filing and rubbing with emery cloth, and the space between conductors was thoroughly cleansed of all emery, copper, or solder particles. The insulation on each conductor was afterwards tapered toward the connectors to increase the leakage path to the outer layers. Compound was then packed in the recess between each connector, and the pencilled ends of the corresponding conductor insulation and impregnated jute rove wrapped tightly in this space, each turn being drawn tight so as to force the compound out between the separate turns of the rove. The operation was continued until a straight line was obtained between the highest points of the pencilled insulation and the chamfer on the connector.

Before proceeding with insulating the joint, the outer layer of insulation on each conductor was removed to ensure surfaces free from deposits of moisture and dirt and to secure a more perfect bond for the hand-wrapped insulation which was applied later. This was considered important, as

otherwise discharge paths might occur along these surfaces. A liberal coating of compound was then applied to the conductor to be insulated, and paper tape, impregnated with the same compound under a 29 in. vacuum, was tightly wrapped round each conductor. Each layer of tape received an application of compound before applying the succeeding layer, and each turn was drawn tightly to remove all evidence of air bubbles between layers.

After each conductor had been individually wrapped, the space between conductors was packed with compound and a quantity of impregnated rove fillers were laid parallel with the conductors and pressed into the spaces between them. Before the belt insulation was applied 0·375 in. of the 1·25 in. of conductor insulation left at each end of the splice next to the armour was tapered. Then impregnated paper tape 1 in. wide and 6 mils. thick was wrapped round the three insulated conductors, first filling the concavities at each end of the splice, then extending the tape over the rest of the joint until a belt one and a quarter times as thick as the jacket mill belt had been applied on an even slope. The same precautions to eliminate voids were observed in applying the belt as in insulating the individual conductors.

When the hand-applied belt was completed it was pierced in six places to permit escape of air and free admission of compound. The holes extended through the joint and between the conductor insulation. After removing the cheese-cloth which had been previously bound around the belled ends of the lead, the belt was tightly wrapped with a copper-gauze stocking, made of 30-mesh No. 30 wire, long enough to extend under the lead armour 0·5 in. at both ends. This was smoothed out so it would bear evenly on all parts of the splice and soldered in five places along its longitudinal seam exclusive of the ends. The lead was then beaten down on the stocking and soldered to it, thus establishing a metal sheath around the joint, which has the same potential as the lead armour. This ensures a definite distribution of potential over the conductor insulation and belt, independent of the insulating material later placed between the copper stocking and the lead jacket.

Round the copper-gauze stocking was wrapped cotton wick 1·5 in. wide and approximately 3/32 in. thick. One layer was wrapped over the central portion of the splice, and toward the ends layer on layer was built up to form a reservoir of compound which would supply the single layer by capillary action. Thus the splice is kept saturated even if some of the compound from the splice is absorbed during service by the cable. The lead sleeves was applied in the usual way, but pipe taps were provided at each end for connecting apparatus used in exhausting air from the joint and filling it with compound.

After the suction and filling apparatus was disconnected a 1-in. pipe nipple with a coupling attached to provide a female thread for the splice plug was connected to one end of the splice and in the other end was screwed a self-acting grease cup. Compound was poured in the cup in a liquid state and permitted to overflow through the nipple at the other end of the splice. When a clear surface of compound was presented at the nipple the plug was screwed in. The cup was then filled with compound and the T-handle screwed up to the highest point so the spring-actuated piston would feed compound into the splice while contraction of the compound due to cooling or absorption by the cable was in process. After twenty-four hours the grease cup and the nipple on the other end of the splice were substituted by plugs if the amount of compound absorbed by the splice appeared normal.

Preparation for Trade after the War.—Considerable progress has been made with the scheme of the Manchester Engineers' Club for the general organisation of the engineering industry, which we referred to on p. 468 of our issue for Nov. 25th, 1915, and p. 30 of our issue for Jan. 29th this year. The organisation which the Manchester Engineers' Club Special Committee suggested should be created has taken the form of the Council for the Organisation of British Engineering Industry, and all the largest firms in the immediate Manchester district have joined. The Council is now devoting itself largely to securing the co-operation of manufacturers in London, the Midlands, and the North-East Coast, and hopes to add very considerably to the present membership of 200.

The Tasmanian Government Power Scheme.—It is stated that power from the Great Lakes electric power scheme will be available for use in Hobart at the end of this month. There have been considerable delays arising out of the war, and even to obtain current as suggested will involve some temporary arrangements with regard to the transmission line.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

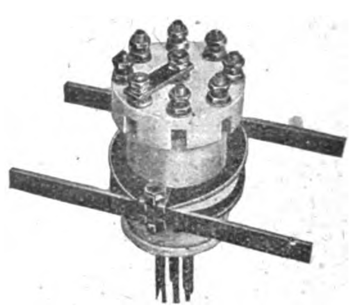
At a recent meeting of the Physical Society a Paper entitled "The Laws of Variation of Resistance with Voltage at a Rectifying Contact of Two Solid Conductors, with Application to the Electric Wave Detector," was read by Mr. D. Owen. The Paper contains an account of an investigation, the primary object of which was to determine the nature of the physical actions occurring at a rectifying contact. Resistance characteristics are given for various contacts, some including a mineral, some in which both elements are metals. It is shown that a specific characteristic may be drawn for any given pair of materials. The experimental results are in accordance with the view that the actions are thermo-electric, the main determining factors being the thermo-electric power and the temperature-coefficient of electric resistance. Based on the law of constancy of the voltage-coefficient, calculations are given showing the best value of the resistance of the telephone in a wireless receiving circuit in which the contact detector is employed. The influence of a polarising voltage is also traced. The use of the combination of rectifier with a direct-current galvanometer as indicator of the balance point in an alternating-current bridge is examined, and it is shown that the minimum detectable alternating voltage cannot be reduced much below a millivolt.

We learn from the *Post Office Electrical Engineers' Journal* that the adoption of automatic telephone exchange working is proceeding apace in Norway, where the Telegraph Administration has placed an order with the Western Electric Co. for equipment for nine fully-automatic exchanges for initial capacities of 6,000, 4,000, 2,000, 2,000, 13,000, 1,000, 1,000, 1,000, and 100 lines respectively. Mr. L. Kristiansen will be in charge of the reconstruction work, which is expected to take six years.

The *Post Office Electrical Engineers' Journal* quotes from the *Telegraph and Telephone Age* an incident in connection with the restoration of the cable cut at Fanning Island, in the Pacific, early in the war by the German cruiser *Nürnberg*. The lost end, which had been towed out to sea, was located in 40 ft. of water by H. Gregg, an operator at the Fanning Island station, by the aid of a glass-bottomed boat, in which he cruised about for several days. Finally, he dived into the shark-infested waters at the risk of his life, and after several attempts succeeded in attaching a line to the cable.

A MOUNTING FOR PORCELAIN INSULATORS

A NEW form of insulator for fixing to metal parts of apparatus such as transformers, oil switches, &c., has been developed recently by Messrs. Ferranti, Ltd. (Central House, Kingsway). The method of fixing is the subject of a recent patent granted to J. Roothaan and Ferranti, Ltd. The insulator itself, one pattern of which is illustrated in the figure, consists of a main body with a flange slotted at the sides to clear the bolts, which clamp a pair of suitably shaped annular plates, which, together with clips, are secured to the side bars or other framework to which the insulator is to be secured, and are turned up to lock the nuts when secure. The device, which does away with all cement, and fixes the insulator firmly in position, is also used to secure porcelain bushings in iron switch panels, and, in fact, in almost every case where insulators have to be fixed to metal parts. The illustration shows an insulator used for transformer terminals.



FERRANTI TRANSFORMER TERMINAL.

Faraday House Electrical Engineering College.—The following awards were made at the recent scholarship examinations: A Faraday Scholarship of 50 guineas per annum, tenable for two years in College and one year in Works, to F. I. Ray, of Bournemouth School; A Maxwell Scholarship of 50 guineas per annum, tenable for one year in College and one year in Works, to C. F. Fowler, of Brighton Grammar School; an Entrance Exhibition of 20 guineas per annum, tenable for two years, to W. Parr-Dudley, of Cranbrook School.

"ELECTRICAL ENGINEERING" PATENT RECORD

Specifications Published May 4th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

2,163/15. **Telegraphy.** E. C. R. MARKS (*Delany Foreign Co.*). An automatic tape-operated telegraph system in which each signal impulse is initiated by imparting to the line a recording current weakened by an opposing current, is continued by the recording current unopposed, and is terminated by a strong current of opposite polarity, which remains unopposed on the line until the succeeding signal impulse is initiated. (Eight figures.)

5,210/15. **Current Limiter.** E. T. RUTHVEN MURRAY and G. F. SHOTTER. Apparatus for preventing or indicating excess currents which, while responding to a permanent overload, will not be affected by sudden or temporary excessive surges of current. This is attained by providing an alternative circuit for the current through the device in parallel to that controlled by a switch arranged to be opened only when the automatic switch is reclosed after an excessive flow of current has caused it to open. The closing movement of the alternative switch is arranged to occur only after a predetermined time has elapsed from its opening. (Five figures.)

5,557/15. **Rectifiers.** B. T.-H. Co. (*G.E. Co., U.S.A.*). A rectifier comprising a vitreous envelope containing a cathode of highly refractory material, such as tungsten, adapted to be heated to incandescence, one or more anodes of considerable heat dissipating capacity and a filling of inert gas or vapour at a pressure sufficiently high to prevent disintegration of the cathode. (Four figures.)

5,783/15. **Wireless Telegraphy.** MARCONI'S WIRELESS TELEGRAPH Co. and C. S. FRANKLIN. A duplex wireless system in which two similar directive aerials, each consisting of two vertical frames at right angles to one another, are erected at equal distances from the transmitting station at a distance apart which is a considerable fraction of the wave length. The moving coil of a radio-goniometer connected to each directional system is connected to a pair of wires leading receiving apparatus, which is preferably arranged midway between them. Condensers are introduced into the circuits comprising the leading wires, the moving coils of the radio-goniometers, and the coils of the receiving apparatus, in order to tune to the desired wave. (Two figures.)

7,826/15. **Transformers.** S. Z. DE FERRANTI and FERRANTI, LTD. Transformers in which the windings are held up against the seatings by resilient members so that no reversal of thrust takes place on the occurrence of an excessive current. (Thirteen figures.)

7,327/15. **Oil-insulated Apparatus.** S. Z. DE FERRANTI J. ROOTHAAN and FERRANTI, LTD. Avoidance of sludging in transformer, and other insulating oil by preventing the access of air to the surface, owing to the presence of a float nearly fitting the sides of the case. (Four figures.)

Restoration of Lapsed Patent

10,774/10. **Telephone Receivers.** N. BALDWIN. An order has been made for the restoration of this patent, which had become void. The specification describes a telephone receiver with a light magnetic armature attached by a rod to a non-magnetic diaphragm.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: DOULTON and PODMORE [Machines for shaping insulators] 5,757/15 & 3,780/16 (100,261).

Ignition: BURTON [Sparking plugs] 7,364/15.

Switchgear, Fuses and Fittings: DULLINGHAM [Shade carrying lamp-holder] 9,697/15; BROWN [Lamp-holders] 13,600/15.

Traction: MOSSAY and MOSSAY & Co. [Electric tip-waggons] 5,743/15; MACKENZIE [Signalling] 6,542/15.

Miscellaneous: BABCOCK & WILCOX, LTD. [Air-cooled tanks for electrical apparatus] 4,263/15; MELLERSH-JACKSON (*Submarine Signal Co.*) [Mounting of electric oscillators for submarine sound signalling] 5,630/15; B. T.-H. Co. (*G.E. Co., U.S.A.* [Electrical apparatus in which resonance may occur] 5,918/15; DE CAPITANI [Tapes containing parallel electric wires] 7,016/15; G. GILES [Electrolytic condensers and valves] 3,534/16 (100,157).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Electrometallurgy: MACKAY COPPER PROCESS Co. [Electrolytic battery] 1,278/16 (*100,264*).

Telegraphy: Soc. FRANÇAISE RADIO-ELECTRIQUE [Wireless] 5,458/16 (*100,281*), 5,466/16 (*100,282*), and 5,471/16 (*100,283*).

Miscellaneous: SIEMENS & HALSKE A.G. [Relays] 369/16 (*100,262*); Soc. ANON. DES ETABLISSEMENTS BLERIOT [Internal combustion engines coupled to dynamos] 3,817/16 (*100,268*).

Opposition to Grant of Patents

Appeal lodged.

23,676/14. **Heating Apparatus.** F. S. GROGAN. An appeal has been lodged against the decision of the Comptroller to grant a patent on their application, in spite of opposition. The specification describes a heating element composed of flat metallic tape coiled into a helix with slightly separated convolutions. When a number of these are assembled into a grid, the convolutions near the centre of the grid are spaced further apart than at the edges to equalise the temperature.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

11,085/02. **Crane Control.** STOTHERT & PITT and E. EVANS. A brake for electric cranes interlocked with the Controller.

The following are the more important Patents that have become void through non-payment of renewal fees.

Battery Plates: A. J. BOULT (*E. W. Smith*), 839/05.

Cables: W. T. HENLEY'S TELEGRAPH Co. and J. H. W. PFIFFNER, 1,155/03.

Association of Supervising Electricians.—The meeting announced for May 16th will not take place owing to the author of the Paper intended to be read, Mr. F. Charles Raphael, having received a Commission in the London Electrical Engineers. It has consequently been impossible to prepare the Paper in time. Other arrangements are being made, of which due notice will be given.

Trade with Spain.—We have on many occasions called attention to the necessity for British manufacturers keeping in touch with foreign markets, notwithstanding the war, and a warning now comes from Spain that German interests are very active in consolidating their position in the Spanish market. In many branches of industry, including electrical fittings, the Germans before the war had a strong hold in Spain, but the present is considered a good moment for introducing United Kingdom manufactures. Our Consular Agent-General at Bilbao therefore strongly recommends British firms to pay attention to this market.

Erratum.—In last week's Patent Record the number of the specification by G. S. Boothroyd and Callender's Cable & Construction Co. for cable clamps should have been 503/16.

LARGE CONTINUOUS-CURRENT SWITCHBOARD

WITH the increasing demand for electrical energy for lighting, power and traction in our big towns, the switchgear and controlling apparatus for the current grows at a corresponding rate. Even though municipalities and supply authorities have adopted high-tension systems of distribution to sub-stations with a low voltage supply from these stations, the size of the continuous-current switchboard necessary for this low voltage distribution nowadays far exceeds the size of the switchboards originally installed in the main power-

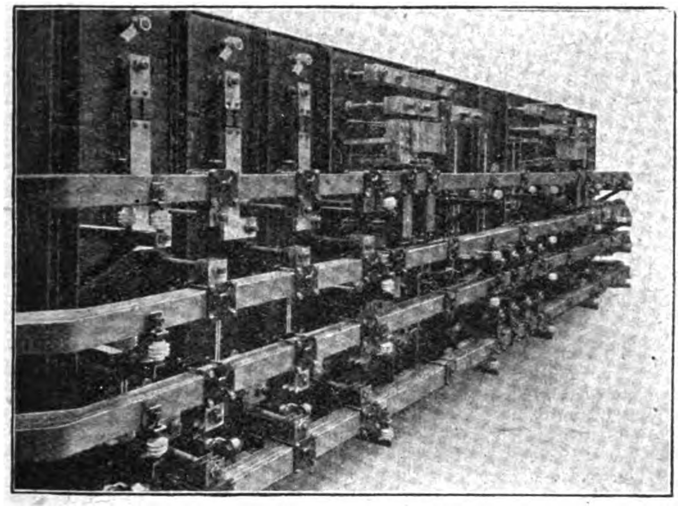


Fig. 1.—Back View of Middle Portion of Heavy Current "Witton" Switchboard for British Municipality.

houses from which the continuous current was supplied. During the last few years the General Electric Co., Ltd., of 67 Queen Victoria Street, London, E.C., and Witton, Birmingham, have produced a considerable number of heavy-current switchboards for various municipalities, and a recent example of this class of board is shown in the accompanying illustrations. This board consists of 23 panels, comprising generator panel for controlling the continuous-current side of two 1,620-kw. motor-generators with Witton-Kapp phase advancers. The board also includes a large number of feeder panels for distributing the energy. It has been constructed to the engineer's

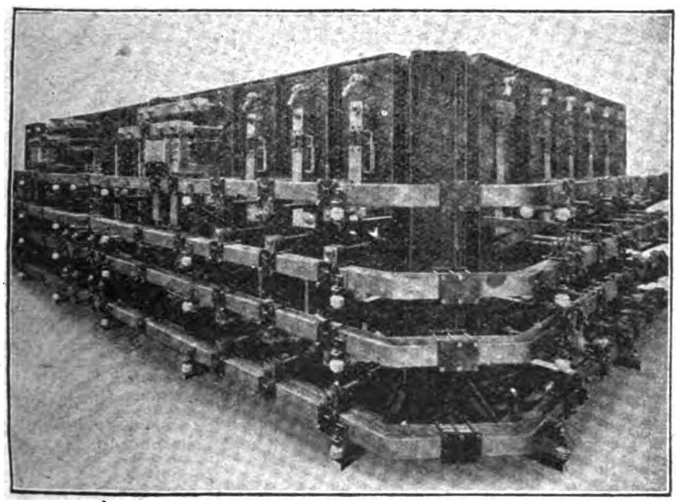
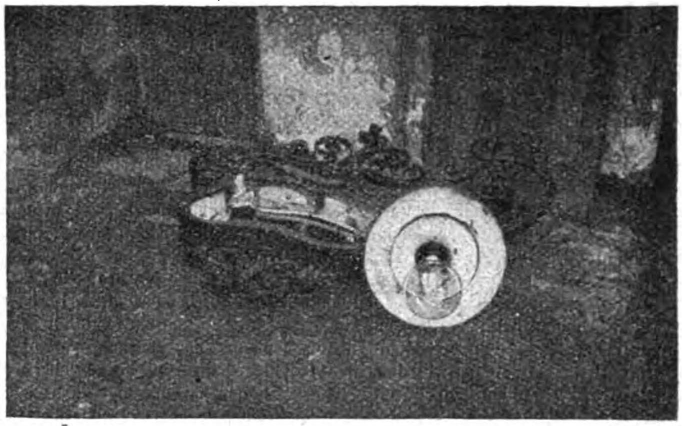


Fig. 2.—View of "Witton" Board, showing one of the side portions.

requirements in a form occupying three sides of a rectangle. In consequence it was not possible to obtain a complete photograph of the back of the board, but the two views given illustrate the middle portion, and one side. The panels have a thickness of $2\frac{1}{4}$ ins., being composed of oiled slate slabs; in addition all the circuit-breakers are mounted upon their own slabs, $2\frac{1}{2}$ ins. thick. The circuit-breakers controlling the generators have a capacity of 10,000 amps. Some idea of the heavy nature of the switchboard can be gained from the size of the shunts, and of the 'busbars, the latter being composed of 24 strips of copper each 4 ins. by $\frac{1}{8}$ in. thick.

STRENGTH OF OSRAM-ATMOS TYPE LAMP

A PROJECTING bracket, beneath which was suspended an opal glass sign with the magic letters "G.E.C." upon it, was blown down during one of the recent gales outside the branch premises of The General Electric Co. at Swansea. As will be seen from the accompanying illustration, the bracket terminated in a hook bearing a reflector and an Osram lamp.



It will be noted that the opal sides of the sign are completely smashed, so that the impact with the pavement must have been pretty considerable. In spite of the wreckage, however, the 1,500-watt Atmos type Osram lamp was found to be unbroken, and, when tested, lighted up as usual. This is a striking testimony to the fact that the filament of the Osram-Atmos type lamp possesses the same remarkable toughness characteristic of the standard Osram.

INSPECTION LAMPS

AN illustrated leaflet from Simplex Conduits, Ltd. (Garrison Lane, Birmingham), deals with electric inspection lamps for shells and other articles, such as casks, carboys, &c., where it is necessary to inspect the interior and is only possible to do so through small apertures. Several designs are illustrated, the largest being designed for inspecting the interior of hogsheads. This is fitted with a spigot for removing stray corks. The smallest lamp shown is designed for the inspection of 18-pounder shells or other small work. Some of the lamps are fitted with small switches in the handles, some are without switches, whilst one type is fitted with a standard tumbler switch in a convenient position near the handle. This is a specially robust design for munition works. All the fittings are sent out complete with lamps and flexible, with earth wire connected.

CATALOGUES, PAMPHLETS, &c., RECEIVED

LIGHTNING ARRESTERS.—We have received from the British Thomson-Houston Co., Ltd. (Rugby), a list describing their "type MD2" lightning arrester for continuous current circuits. This arrester consists of a single spark gap with a non-inductive resistance in series therewith to limit the discharge current. The spark gap is protected by a magnetic blow-out coil, connected in parallel to part of the resistance. The lightning discharge passes directly through the spark gap and resistance to earth, and should any current from the supply system follow the lightning discharge and tend to maintain the arc, a portion of such current will pass through the blow-out coil and produce a strong magnetic field, thereby blowing out the arc.

A NEW PAY WALLET.—We have received from Messrs. Martin Billing, Son & Co. (Livery Street, Birmingham) specimens of a new pay wallet which has been designed to facilitate the paying of wages. A special feature of it is the locking effect obtained, whereby the notes project from the wallet, and can be handled by the workmen without breaking the case open. The front of the wallet is perforated, leaving the cash in the wallet visible.

FORCED DRAUGHT FURNACES.—Messrs. Meldrums, Ltd., of Timperley, Manchester, send us their new catalogue describing the "Meldrum" forced draught furnace. The principle on which the furnace works is that of the steam-jet forced draught. Their blowers, superheaters, and firebars are separately described. Up to the present time over 16,000 of these furnaces, representing in steam production some two million horse-power, are said to have been fitted.

A NEW METHOD FOR RECORDING THE LOCATION OF BULLETS

A DEMONSTRATION of a new X-ray apparatus was made recently in Munich by Prof. A. Hasselwander, who, it is stated, has used the apparatus most successfully in field hospitals on the west and east fronts. The simple X-ray photograph is merely a shadowgraph produced by rays radiating from a central point, and is always distorted and gives little idea of shape, size, and position of the foreign body. Over 150 different methods, many of them based on stereoscopic principles, have been devised for locating the body. In these methods two photographs are taken from two separate X-ray tubes, the cathodes being placed at a distance apart equal approximately to the distance between the human eyes. A stereoscopic picture of the bullet or other body and its surroundings is then obtained which, when viewed under the correct conditions, gives a correct idea of the location, form, &c., of the body.

The apparatus developed by Prof. Hasselwander is to enable the stereoscopic picture to be recorded automatically in all three dimensions of space in an exact scale of measurement, so as to give a permanent record of the case. An instrument used in land surveying, and known as a stereo-planigraph, is employed for the purpose. The two stereoscopic photographs are viewed by means of mirrors so lightly silvered that one can see a small source or brilliant spot of light behind the mirrors, that is, where the stereoscopic and apparently solid image appears to be. This spot of light is then moved about in all three dimensions of the space apparently occupied by the image, and can be placed so as to coincide with any part of the bullet or other foreign body or its surroundings, and the position in space relative to any fixed point permanently recorded by means of the stereo-planigraph to which the bright spot is attached.

An automatic modelling of the image is said to be possible by attaching to the bright spot a stiff needle, which then will follow the movements of the bright spot in all three dimensions, and can be made to reproduce the form of the image in a solid material in the same manner as a sculptor's point-pantograph for reproducing a piece of modelling.

Prof. Hasselwander stated that he had investigated over 600 cases with this apparatus, but that owing to various reasons, such as broken bones, unhealthy condition, &c., the greater number of cases had not proved suitable for operations. In over one hundred cases, however, he had performed successful operations, each of which had proved the correctness of the space location by the above method.

ELECTRIC TRACTION NOTES

The advocates of battery-driven vehicles will be interested in the result of the experiment now being carried out at Bradford with a combined trolley and battery goods wagon. Mr. C. J. Spencer, the Tramways Manager, has devised a vehicle which can take power from the tramway trolley wires when the vehicle is running over tram routes, and which is also fitted with batteries for propelling it along other roads. There are considerable possibilities in vehicles of this description.

Bolton Town Council have approved an item in the Electricity Committee's proceedings to the effect that "the electrical engineer be requested to instal a charging station for electrically-driven vehicles at the Spa Road Electricity Works, and that a copy of this resolution be transmitted to the various committees of the corporation using vehicles, calling their attention to the enormous advantages in cleanliness, health, and economy gained by the substitution of electrically-propelled vehicles for horse vehicles or other means of traction, and that the chairman, vice-chairman, and Councillor Crowther, together with the electrical engineer, be deputed to confer with the several committees of the corporation using horse or other vehicles."

The Leeds Corporation Tramways receipts were a record for last year, and as a result £71,822 are to be transferred to relief of rates after placing £15,000 to reserve fund.

There was a loss of £64,000 on the L.C.C. Tramways last year, which is considerably less than was anticipated, having regard to the fact that the strike involved a loss of revenue of £100,000.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Whittaker's Arithmetic of Electrical Engineering. 212 pp. 7½ in. by 5 in. 18 figures. (London: Whittaker & Co.) Third editon. 2s. net; by post, 2s. 3d.

The working out of arithmetical problems connected with electrical engineering should form an essential part of a student's training, and this book contains a selection of graduated problems suitable for practice. The present edition is a considerable enlargement on previous ones, and contains 375 exercises besides 81 examples fully worked out. Included are many numerical questions set at the City & Guilds Institute Examinations in Electric Lighting & Power-Transmission, and Telegraphy and Telephony, as well as questions taken from the Institution of Electrical Engineers' Associate Membership Examination Papers for 1914 and 1915. The book, we believe, would have been more generally useful if some questions had been included of a little more advanced character, but otherwise it is a very good collection of arithmetical problems.

A Treatise on Electricity. By F. B. Pidduck. 646 pp. 9 in. by 5¾ in. 369 figures. (Cambridge: The University Press.) 14s. net; abroad, 14s. 10d.

This is a book we can recommend to those who are interested in the subject of electricity as a branch of physics rather than to electrical engineers. Though complete in itself, the book is not intended for beginners, but will be most useful to those who have already had a good grounding in the elementary theory and mathematics of the subject. The book falls naturally into two sections, the first part being fairly simple and containing all the principles necessary for a right appreciation of the subject, while the remaining chapters form introductory accounts of special subjects, which may usefully be consulted by students before starting on treatises devoted to them alone. These subjects include electrolysis, electric oscillations, conduction of electricity through gases, radioactivity, and the theory of electrons. We might also add to these special subjects that of electrical engineering or "applied electricity," as the author terms it, for his contribution to this branch may be described as an elementary introduction to the subject from the point of view of the mathematician.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Belfast.—Mechanical stokers are required at the Electricity Works. (See an advertisement on another page.)

Bo'ness.—The Secretary for Scotland has intimated his willingness to sanction a loan of £12,000 for extensions repayable in twenty years.

Manchester.—The Electricity Committee require automatic coal-handling plant and 200 b.h.p. A.C. or D.C. motors for the Stuart Street power-house. Chief Electrical Engineer, May 17th.

Rochdale.—There was considerable opposition at the meeting of the Corporation last week to a proposal of the Electricity Committee to spend £60,900 on extensions at the Electricity Works. The Chairman of the Committee explained that the expenditure is necessary to meet the growing demands for current, but in deference to the opponents a special meeting of the Corporation is to be held to discuss the matter in Committee.

Wigan.—The Corporation has sanctioned an expenditure of £53,920 for an extension scheme planned by Mr. H. Dickinson, the Liverpool city electrical engineer, who, as we recently announced, has been called in to advise.

Miscellaneous

Australia.—The Victorian Railway Commissioners require 5,000 6-volt lamps and 1,000 110-volt lamps for their signal system, also 4,000 holders. A copy of the specification may be seen at 73 Basinghall Street, but this information, of course, is only of use to firms who can cable agents.

Canada.—The Department of Public Works, Ottawa, requires 10 knots of single conductor submarine telegraph cable (107 lb. copper and 150 lb. gutta-percha per knot), with galvanised iron wire sheathing. A copy of the specification may be seen at 73 Basinghall Street, but the information, of course, is only of use to firms who can cable agents.

New Zealand.—The Takapuna Electric Tramways Co. is spending £50,000 in electrifying the existing steam tramway. Takapuna is a suburb of Auckland.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Accrington.—The following tenders have been accepted in connection with the extensions at the Electricity Works:—2,000 kw. turbo-alternator, 3,000 r.p.m., 6,000 volts, 50 cycles, British Thomson-Houston Co., Ltd.; cooling tower, the Lancashire Water Cooler Co.; boiler feed pumps, Messrs. J. B. Hall and Sons; feed-water heater, Holden and Brooks, Ltd.

APPOINTMENTS AND PERSONAL NOTES

Mr. J. M. Keenan, deputy electrical engineer and manager at Torquay, who is acting in the absence of Mr. C. W. Salt, on war service, and who recently applied for an increase in salary, has been granted the same war bonus—namely, five guineas per month—which has been given to the assistant borough surveyor in similar circumstances.

The Society of Motor Manufacturers and Traders, Ltd., have appointed Mr. T. C. Pullinger, of Arrol-Johnston, Ltd., to represent this Society upon the Electric Vehicle Committee.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £155 to £161 (last week, £144 to £146).

The London Electric Firm.—Owing to increasing business in all departments, the London Electric Firm (George Street, Croydon) has been compelled to acquire additional space, and in consequence is building new works at Brighton Road, Croydon. Notice of the actual change will be given to the trade shortly.

Plant for Sale.—The Postmaster-General has a quantity of pipes and conduits for sale. (See an advertisement on another page.)

LOCAL NOTES

Accrington: *The Electricity Works "Certified."*—The Minister of Munitions has certified the electricity works as a munition factory.

Belfast: The I.M.E.A. meeting.—The Chairman of the Tramways and Electricity Committee and the City Electrical Engineer are to attend the I.M.E.A. meeting in London next month.

Bootle: *Electricity Charges Increased.*—The Electricity Committee have so far refrained from suggesting an increase in charges, in the hope that they would be able to struggle through the war without the necessity for doing this. Here, however, as in so many other places, circumstances have proved too strong, and it has now been necessary to increase the charges for all purposes by 12½ per cent.

Bradford: *Death from Electric Shock.*—An employee of the Bradford Corporation working at the Thornbury sub-station unfortunately met his death last week through coming into contact with the high-tension live wire.

Burnley: *I.M.E.A. Meeting.*—The Electricity Committee has decided not to send any delegates to the annual meeting of the I.M.E.A. in London on June 22nd and 23rd.

Edinburgh: *Position of Electricity Undertaking.*—In putting the scheme for an increase in charges—recently referred to in our columns—before the Council last week, the Convenor of the Electricity Committee stated that it was necessary to increase the charge by ¼d. per unit for lighting, and also to make the contributions to the sinking fund on the basis of 30 years instead of 25 years in order to avoid a probable deficit of about £17,000 on the year's working. The scheme was adopted.

Gloucester: *Labour Difficulties.*—The Electrical Engineer is finding it impossible to obtain men with sufficient technical knowledge and central station experience to fill vacancies occasioned by military requirements, and has been authorised to make such arrangements as he considers best in order to rearrange the duties of those remaining.

Middlesbrough.—The Cleveland & Durham County Electric Power Co., Ltd., has written the corporation stating that, owing to the cost of producing current having risen so considerably of late on account of the diminished output of units from the waste-heat stations and the consequent heavy consumption of coal at enhanced prices and other additional costs incidental to the war, they are compelled to raise the question of the price paid for current by the corporation, and proposing an advance in price temporarily by 15 per cent. as from January 1st, 1916, until six months after the termination of the war. The letter has been left with a sub-committee pending a proposed meeting of the principal consumers of the Power Co., the Chairman of the Gas & Electricity Committee (Councillor J. Calvert) to report.

Rotherham: *Satisfactory Progress.*—In his annual report for 1915–16, Mr. E. Cross, the engineer and general manager of the electricity undertaking, records with satisfaction that his department has recovered the top position which it lost last year in being the most financially successful among the recorded results of over 200 undertakings owned by local authorities. The results are mainly due to the fact that the orignal plant is not now used for generating purposes, the change-over to the more efficient turbo-generating machinery having brought about a beneficial effect in almost every item of the cost sheet. The total generating costs were 0·617d. per unit against 0·7d. last year, the actual cost in money being £17,940 against £16,169, an increase of only £1,761, in spite of the fact that the cost of coal, materials, &c., has increased enormously. The gross profit for the year was £15,272, an increase of £4,121 over the previous twelve months.

St. Annes-on-Sea: *Decreasing Lighting Revenue.*—The output for lighting purposes last year showed a decrease for the first time over that of previous years. The output for industrial power, however, showed a large increase. whilst there has also been a satisfactory increase in the supply for heating and cooking purposes. Charges for electricity for all purposes are to be increased 15 per cent.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Babcock & Wilcox.—The net profit for 1915 was £396,551, to which is added £69,492 brought forward. A dividend of 9 per cent. free of tax is declared on the ordinary shares, and after placing £150,000 to reserve and £10,000 to staff pension fund, a balance of £42,125 is carried forward. The Company has been declared a "controlled establishment." At present the works are largely engaged in the manufacture of boilers and munitions for the Government, and large extensions to the works are being carried out.

South Wales Electrical Power Distribution Co.—At the annual meeting last week the accounts given in our issue for April 20th were adopted. As there was no revenue account to be submitted to the shareholders, the proceedings were necessarily brief, and Mr. W. Gascoyne Dalziel, the Chairman, took the opportunity of expressing his satisfaction that the debenture holders were now receiving their interest after so many years' suspension. There was every prospect, he said, of progress.

Electrical Wholesalers' Federation.—The annual general meeting took place on Wednesday, April 26th. The chairman, Mr. R. W. Smith, in presenting the report of the committee and reviewing the work of the year, said that many questions affecting the wholesale electrical trade had arisen, which the E.W.F. had been able to negotiate successfully. He appealed for more support from *bona fide* wholesale firms, so that the Federation should be thoroughly representative. Wholesale electrical firms desirous of becoming members can obtain all information from the Secretary, Electrical Wholesalers' Federation, Ltd., Amberley House, Norfolk Street, W.C.

TRADES DIRECTORY OF ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
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Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Poulton Bros., Ltd., 38 and 39, Cowcross St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 64, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
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Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

FLEXIBLE METALLIC TUBING.
United Flexible Metallic Tubing Co., Ltd., 112, Queen Vict. St., E.C.

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The Bastian Elect. Heating Syndicate, Ltd., 185, Wardour St., W.C.

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Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Record Electrical Co., Ltd., Caxton House, Westminster. S.W.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
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Phœnix Assurance Co., Phœnix House, King William St., E.C.

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LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
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Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

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London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

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Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

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Bastian Meter Co., Ltd., Kentish Town, N.W.
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Reyrolle & Co., Ltd., Hebburn-on-Tyne.
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STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
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Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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SUMMARY

THE annual general meeting of the Institution of Electrical Engineers was held last Thursday, the president occupying the chair. The council's report and statement of accounts for the year were received and adopted (p. 178).

THE Electric Lighting of small towns forms the subject of a long paper read last week before the Junior Institution of Engineers by Mr. H. N. Munro. The organisation, engineering problems, and financial aspects of the case are separately and fully dealt with. It is shown that an average dividend of 5 per cent. on Ordinary shares has been paid in towns with populations of 2,500 to 10,000 (p. 178).

EXPERIMENTS have been made in the United States with iron wire for small transmission lines. It is found to be satisfactory and economical for certain cases where small loads have to be transmitted over considerable distances (p. 179).

IT is suggested that electric supply authorities should subscribe to the funds of the Illuminating Engineering Society, having regard to the value of the propaganda work it is carrying out. A list of subjects which the Research Committee of the society now has under consideration is given (p. 179).

AMONG the subjects of specifications published at the Patent Office last Thursday are transformer tanks and windings arranged to prevent resonance effects (p. 180).

OUR Questions and Answers page this week deals with the subject of testing after repairing a joint box of a three-phase cable feeding overhead lines (p. 181).

AT the May meeting of the Diesel Engine Users' Association the accident to a Diesel engine air compressor at Smithfield Markets wa further discussed. A representative of the manufacturers of the compressor was present and gave the firm's theory of the accident (p. 181).

WE publish an account of the equipment of the automatic telephone exchange at Portsmouth. This is the largest automatic service in this country, exceeding the total of the equipments of all previous similar exchanges, and it embodies the latest developments in automatic telephone working (p. 182).

IN an address at Glasgow, Mr. T. C. Elder emphasised the necessity for active preparation for continuance of the economic struggle with Germany after the war is over (p. 183).

THE Belfast electrical contractors are urging the Corporation to connect new consumers in the normal way and not to reject them during the war.—The Board of Trade last week held an inquiry into the proposal of the Charing Cross, West End, and City Electricity Supply Company to increase their charges.—There was a record profit of £17,000 upon the Belfast electricity undertaking last year.—A 5,000 kilowatt Westinghouse-Rateau steam-turbo generating set has been put into operation at Greenock (p. 185).

MAINS, transformers, switchgear, and house services are required at Hammersmith; a switchboard at Hampstead; sub-station equipment at Wolverhampton; mains at Greenock and Carlisle, and generating plant at Accrington (p. 185).

Arrangements for the Week.—*Monday, May 22nd.*—Royal Society of Arts. Afternoon Lecture. III.: "Vibrations, Waves, and Resonance." 4.30 p.m.
Friday, May 26th.—Royal Institution. Evening discourse by Prof. C. G. Barkla on "X-Rays." 5.30 p.m.

1st LONDON ENGINEER VOLUNTEERS

ORDERS FOR THE WEEK BY LIEUT.-COL. C. B. CLAY, V.D. COMMANDING.

Officer for the Week.—Platoon Commander J. O. Cheadle.
Next for Duty.—Platoon Commander J. R. G. Williamson.
Monday, May 22nd.—Technical for Sections 1 and 2, No. 3 Company, 46 Regency Street, S.W. Squad and Platoon Drill, Sections 3 and 4, No. 3 Company. Signalling Class and Recruits.
Tuesday, May 23rd.—School of Arms, 6–7. Lecture, Mr. J. Roberts, "The Geology of Oxford," 7.15. Recruits, 7.15–8.15, Archbishop's Park.
Wednesday, May 24th.—Platoon Drill, No. 2 Platoon, No. 1 Company
Thursday, May 25th.—Platoon Drill, No. 6 Platoon, No. 2 Company. Shooting for Sections 3 and 4, No. 3 Company, Miniature Range Recruits, 5.45–7.45. Instructional Class, 5.45.
Friday, May 26th.—Technical for Sections 3 and 4, No. 3 Company, 46 Regency Street, S.W. Squad and Platoon Drill, Sections 1 and 2, No. 3 Company.
Saturday, May 27th.—Route March: Parade Golder's Green Station, 2.30. Uniform. The Corps will be accompanied by a drum and bugle band.
Sunday, May 28th.—Entrenching at Otford: Parade Victoria (S.E. and C. Ry. Booking Office), 8.35 a.m. Uniforms, haversacks, and water-bottles. Midday rations to be carried. Railway vouchers will be provided.
Note.—Unless otherwise indicated, all drills, etc., will take place at Chester House.

Electric Smelting of Zinc.—H.M. Trade Commissioner for Canada (Mr. C. Hamilton Wickes) has forwarded the following particulars regarding a new zinc smelting plant at Trail, B.C.:—This smelter is a new departure from those in existence; the metal is treated electrically, and the method adopted, which is the result of three years' experiments made locally, has been proved to be sound. After the outbreak of war, when the world's scarcity of zinc was critical, the British Government, negotiating through the Dominion Government, made an offer of 5,000 tons of zinc at a price of 8 cents (4d.) per lb. This offer was later handed over to mining interests at Trail, with the result that they decided to start the plant now practically completed, claiming that, from experiments made, they could produce zinc from their own ores at a price of about 4½ cents per lb. The plant is divided into four buildings—roasting, dissolving, electrical, and power generating. The electrical building at present constructed has a capacity of only 5 tons a day, but the roasting chamber of the plant is capable of handling as much as 12 tons a day. The ore at present used is from local mines and is very refractory, but it is understood that a better grade of ore is to be used and the capacity thereby materially increased.

Applied Science at Sheffield University.—The late Mr. Edgar Allen, of the great Sheffield steel firm, has under his will left to the University of Sheffield the sum of £32,000, of which £5,000 are to be used in the Applied Science Department in conjunction with another £5,000 given by Mr. Joseph Jonas in connection with the provision of a material-testing laboratory to be called the Allen and Jonas Laboratory.

ANNUAL MEETING OF THE INSTITUTION OF ELECTRICAL ENGINEERS

THE Annual General Meeting of the Institution of Electrical Engineers was held on Thursday, May 11th, Mr. C. P. Sparks, the President, being in the chair. An abstract of the Council's Report was given on page 161 of our issue of May 4th. The President called attention to the military distinctions which have been awarded to members during the war, and to the fact that 34 members had lost their lives in the service of the country; he also referred to the deaths of Mr. C. E. Spagnoletti, Past-President; Professor Eric Gerard, Honorary Member, and Mr. Robert Hammond, Honorary Treasurer. With regard to examination of candidates for Associate Membership, the Council had decided that during the war any candidate for admission who is engaged on naval or military service, or employed (whole-time) in an engineering capacity on munitions or other war work, will be exempted from complying with the examination regulations.

The Council had had under consideration a scheme for the employment of disabled soldiers and sailors. Letters had been sent to a number of electric supply undertakings to ascertain whether they could employ such men, provided that they have received some sort of preliminary training. Satisfactory replies had been received, and the manner of arranging for the training of these men, obtaining means for carrying out the same, and selecting and distributing applicants for positions, were now being considered. A preliminary guarantee fund of over £300 had been established for this purpose by past and present members of Council.

The Committee of Management of the Benevolent Fund of the Institution reported that on December 31st, 1915, the Capital Account of the Fund stood at £4,642 3s. The donations and subscriptions to the fund in 1915 amounted to £777 2s. 7d., including a legacy of £250 from the late Mr. Augustus Stroh. In the course of the year seven grants were made, amounting to a total of £126.

The Council had decided that on account of the war the annual dinner and conversazione should not be held this year.

After a few questions had been asked by members, the Report and Statement of Accounts for the year were adopted.

THE ELECTRIC LIGHTING OF SMALL TOWNS

IN a long Paper read last week before the Junior Institution of Engineers, Mr. H. N. Munro dealt very fully with the problems involved in the equipment of small towns with lighting installations. In country towns and villages it is rarely that a power-station is put down unless for the immediate purpose of providing light; the power load follows the adoption of electric lighting. The idea is prevalent in the lay mind that an electric undertaking will not pay unless developed on a large scale, and that to attempt to put down an electric generating station and provide electric light and power in a place of less than 10,000 inhabitants is to court disaster. This impression is entirely erroneous, and the author points out that villages with populations as low as 500 have found that it is a profitable venture to follow the times and use electricity in place of oil or gas. These concerns are not only self-supporting, but they manage to yield dividends of 2½ to 5 per cent., and sometimes more after a year or two of working, some of the more successful yielding 10 per cent. after a few years.

It is well to bear in mind when contemplating the promotion of any such schemes that there will always be a certain amount of local opposition which must be overcome—if there is a gasworks in the vicinity vigorous steps will be taken by the owners or shareholders to prevent competition—and no scheme of this nature should be proceeded with until all the opposition—or, at least, most of it—has been overcome.

Assuming that the support of the inhabitants is assured, it is necessary to ascertain how far the local authorities and governing bodies may be expected to favour the scheme officially. This is most important, for, unless the local governing body and the bodies controlling the roads are in agreement with the project, it is useless to proceed further, as the Board of Trade would not sanction the erection of a mains system without the assent of the local authorities being given; and, in any case, the restrictions and hindrances which could be caused by an antagonistic council would render the undertaking a much too costly and unsatisfactory affair.

Again, assuming that consent is given by the governing bodies concerned, the promoters are now in a position to put their project into operation, and the formation of a company can be proceeded with immediately. One of the first questions to arise will be relative to the advisability of seeking a Board of Trade Provisional Order. A prevailing impression is that such an order or authority is necessary before the scheme can be carried out, but this, to a large extent, is not so, as there are many schemes of this nature working without any Provisional Order. The obtaining of a Provisional Order is a lengthy and often an expensive matter, and it places on the undertaker many responsibilities. The only substantial benefit to be got from it is permission to break up roads and streets for the purpose of laying cables, and also the securing of compulsory wayleaves. In the first case, the breaking up of roads is unnecessary, as all mains are run overhead; and, in the second, wayleaves are not very difficult to obtain when the support of the residents in the place is given to the undertaking. Furthermore, the Provisional Order does not convey a monopoly of electric supply to a company, as is commonly thought, since the local authorities can give their consent to any other undertaker to provide an electric supply. This, of course, is unlikely to occur. The monopoly supposed to be granted is that where the Board of Trade have granted a Provisional Order, it would be extremely unlikely that they would sanction another in the same place to a different undertaker. This ensures that the company already in possession of the Order is free from competition as far as underground mains system is concerned, but the company cannot prevent the local authorities from granting permission to a contractor to erect an overhead main system, should such a course be deemed desirable. The Board of Trade does not directly grant permission for these overhead lines to be erected, but, provided that the local authorities give their full consent and that the line is constructed in accordance with the Board of Trade Regulations, no obstacles will be encountered in the carrying out of the scheme. If at all possible, neighbouring villages should be induced to fall in with the proposals, and these should be grouped together, as this will be found to effectively reduce costs per unit and management expenses, besides being conducive to more efficient service.

Dealing with the formation of the company, the author says it is obvious that it should be well supported locally if it is to be successful, and the majority of the shares should be held by the inhabitants of the locality. The articles of association should be drawn up in the approved way, and clauses relating to the selling of fixtures, wiring of premises, and extent of supply should be included in order to give the company full scope for extension. The company should start with full capital and entirely free from all obligations and loans. If sufficient money cannot be obtained at the outset to purchase outright all plant, etc., arrangements can sometimes be made by which contractors will agree to accept shares in the company as part payment of their contract sum.

After dealing in considerable detail with the engineering and technical problems involved, which on the whole are fairly standard and well known to engineers, the author proceeds to deal with the financial aspect. He gives a concrete example of working costs and revenue, taking as an example the case of a town assumed to have a population of 5,000. His figures, based on assumed second year's working, show a total expenditure of £808, of which £525 is for management expenses, and £283 the cost of generation of 68,040 units at 1d. On the revenue side is shown; for private lighting, 28,800 units at 6d.—£720; street lighting, 100 lamps at £3 each per annum—£300; and 150 meter rents at 5s. each per annum—£38; total revenue—£1,058. The profit is, therefore, £250. Of this amount the debenture or preference shares will absorb their dividend of 5 per cent., totalling £75. The balance of £175 remains to satisfy the ordinary shareholders and any reserve or other fund which is contemplated. A dividend of 5 per cent. can be paid on ordinary shares, leaving the sum of £25 to be placed to the reserve or other fund. An average dividend of 5 per cent. has been figured from the statistics of ten companies with populations varying from 2,500 to 10,500, which shows that not only do such undertakings provide an efficient lighting and power supply, but also that they are paying concerns.

In conclusion, the author points out that an undertaking of this kind needs a great expenditure of personal energy in order to maintain a live interest on the part of consumers and non-consumers alike; the personal effort is absolutely essential if the scheme is going to be a success. A canvass of all shops likely to need electric supply might be undertaken with advantage, followed up by a visit to the residential quarter, where, no doubt, many consumers will be obtained as a result of a little tactful dealing. A few simple but "telling" advertisements in the local papers will not fail to arouse interest, while the circulation of carefully written pamphlets may be adopted with success. These pamphlets should state clearly in non-technical terms exactly what electrical energy can do, what it costs for different purposes, and the most advantageous ways to use it. It is a mistaken policy to too strongly condemn gas as an illuminant.

Should the locality be an industrial one, the owners of factories or works should be interviewed and the advantages of electricity as applied to their particular class of work discussed. This, however, should be left until the electric-lighting requirements are fully developed, unless, of course, the power load is likely to be predominant from the outset, when the conditions set out in the paper undergo radical changes. The consumer having been obtained, he has to be retained and kept satisfied. By giving him all the help and advice possible in the wiring of his premises, installation of fittings, etc., the engineer will be assuring himself of an efficient connection and a satisfied consumer.

THE USE OF IRON FOR TRANSMISSION LINES

IN view of the substitution of iron for copper conductors, which appears to be proceeding on a large scale in Germany at the present time, it is interesting to find that tentative work in this direction has been going on for some time in the United States. With the price of copper at double its normal value, the question of a cheaper metal for conductors becomes important for consideration, and some of the power companies in the States have been experimenting with iron for minor work where the length of line was considerable with respect to the load carried. Reports of the operation of these iron lines have been collected from a number of supply companies, and are published in the *Electrical World*. It appears that for lines carrying light loads, such as often obtains with new lines, or extensions, or lines in scattered districts, entirely satisfactory results can be reached with iron, provided the load does not increase to such an extent that the drop becomes unduly great. No attempts appear to have been made to use iron for main transmission lines; probably the losses would be too great to give any economy except under very abnormal conditions. The results hitherto obtained point to the probability that iron lines will not find any permanent place, but are only economical as temporary structures while the price of copper is unusually high, and even then only for light loads.

The results obtained by the United Electric Light and Water Co., Waterbury, Conn., show that it is cheaper for certain small loads to use a line of iron, with iron at 8·25 cents per lb., than one of copper when that metal is 15 cents per lb., and that if copper is 32 cents per lb. it is cheaper to use iron and replace it entirely with copper provided the latter can be obtained at 15 cents per lb. within four years.

The Monmouth (Ill.) Public Service Company operates a three-phase, 13,200-volt, iron-wire line about twelve miles long to furnish energy to the village of Roseville, Ill., from its Monmouth station. The line is constructed with No. 6 iron wire. The peak load of Roseville, a village of 880 people, is about 30 kw. The regulation of the line is satisfactory without the use of a night feeder regulator.

The Public Service Company of Northern Illinois about two years ago began to experiment in its Waukegan district with the use of iron wire on the extreme ends of lines carrying light loads. About forty customers are now receiving supply over iron-wire lines built of No. 8 wire strung on 25-ft. or 30-ft. poles. The principal place in which the use of iron wire has been found advantageous is on the premises of a customer, who, owing to the fact that his residence is an isolated one, standing several hundred feet from the highway, must himself pay for the line extension. Here the substitution of No. 8 iron-wire primaries has relieved the customer of a large portion of the expense called for by using copper, and does not interfere with the quality of service since his load as a rule will not exceed 1 kw.

The Nebraska Gas and Electric Company, Omaha, Neb., operates three iron-wire transmission lines. One of these lines is seven miles long and another twenty-eight miles long. Although the latter line has never been operated up to the capacity of the conductors, its performance has been satisfactory. The sizes of iron wire used are 7/16 in., ⅜ in. and 5/16 in. The line is two-conductor, transposed every two miles and carried on 30-ft. wood poles spaced 125 ft. The operating voltage is 16,500 and the average load 70 kw. The third line extends a distance of fourteen miles; this was built in 1915, and, since being placed in operation, has been subject to greater static disturbances than copper lines. Investigations are now being made to determine the causes, considering the country through which the lines pass, since another short copper line also shows similar disturbance but extends through a somewhat different type of country.

To minimise the cost of providing circuits over which to supply energy to irrigation motors in sparsely-settled districts, the Pacific Power and Light Company has in a number of cases made use of No. 8 copper-clad wire and No. 8 iron wire. The former was used for the reason that it was under normal copper prices—about one-third cheaper than copper wire. The experience of this company has shown, however, that future growth must be taken into consideration before adopting such construction since in many cases the load may grow to such proportions that the voltage drop in the copper-clad steel lines will be excessive. On short 6,600-volt branch lines and other circuits where the load is light, the company has not experienced any trouble with the No. 8 iron wire construction due to excessive voltage drop.

The Southern California Edison Company has used iron wire rather extensively on short branch circuits for 11,000-volt service, where the distance did not exceed a mile and the load not more than 50 kw. It has been found, however, that there are certain operating troubles that can be traced to the use of this construction, and it has therefore been discontinued. The main objection is that often what would be expected to be only a branch circuit at the time of construction would soon develop into a main line, so that the cost of changing the iron wire under normal prices of copper to the proper size of copper conductor would far exceed the interest saved on the copper wire which would have been installed at the beginning.

Owing to rising prices of copper the Cumberland County Power and Light Company at one time considered temporary use of iron wire on a 20-mile, 66,000-volt transmission line for transmitting 3,000 kw. between one of its stations and a new development. Realising that there would be no market for second-hand iron wire, seven-strand, 7/16-in. galvanized-iron wire was the only size considered, it being contemplated that when the price of copper did drop to a value where it would be advisable to replace the iron wire with copper, the iron wire could be used for maintenance purposes. However, it was concluded that a bank of transformers which would not have been necessitated for five or six years' later would be required. This and the fact that the first investment and the yearly fixed charges would have made the iron-wire construction more expensive than copper without giving any corresponding advantages, caused the company to give up the idea.

ILLUMINATING ENGINEERING SOCIETY

THE annual general meeting was held on Tuesday last week, May 9th, Prof. S. P. Thompson, F.R.S., presiding. The report of the Council for the session 1915–1916 states that although during the past year a considerable number of members of the Society have joined the Forces, and additions have been made to the number of those engaged largely or exclusively on war work, the activities of the Society have been fully maintained. The membership of the Society is substantially the same as last year—a result which may be considered very satisfactory in the present circumstances. The President of the Institutions of Electrical Engineers, Mr. Charles P. Sparks, has kindly consented to act on the Council during the present year. Among the losses caused by the war we notice two of the younger members of the Society, Mr. G. Maurice, who perished on the *Lusitania*, and Mr. F. Harvey Gooch, who fell in action with the Cameron Highlanders in France.

After reviewing the work of the session, attention is called to the fact that the report of the Home Office Departmental Committee on Industrial Lighting has been brought to the notice of the Committee now sitting on the Conditions of Health of Munition Workers, and in the bulletins so far issued reference has already been made to the importance of good industrial illumination. Special mention may be made of Bulletin No. 9, on "Ventilation and Lighting of Munition Factories and Workshops," in which attention is directed to the Home Office Report, and the chief essentials of good lighting, as summarised in this report, are repeated. The question of factory lighting has also been receiving the attention of the American Illuminating Engineering Society, and at the last Convention, held in Washington in September, 1915, a most useful "Code for the Lighting of Factories, Mills, and other Work-places," prepared by a Committee of the Society, was presented. A series of lectures on various aspects of illuminating engineering is also being arranged.

An important question that has been receiving much attention, both in this country and abroad, is the desirability of arriving at a uniform method of expressing the efficiency and illuminating value of gas, electricity, and other illuminants. The view is receiving support that lamps should be rated in terms of the total output of light in all directions. The following resolution has been proposed by the Committee of the American Illuminating Engineering Society on nomenclature and standards, and subsequently approved by the Council of that Society:—

"(A) That the output of all illuminants be expressed in lumens; (B) that illuminants should be rated upon a lumen basis instead of a candle-power basis; (C) that the specific output of electric lamps should be stated in lumens per watt, and the specific output of illuminants dependent upon combustion should be stated in lumens per Board of Trade unit per hour."

The Council consider that the moment is opportune to proceed with the work of the Committee on Research, the appointment of which was decided upon in 1914, but was delayed owing to the outbreak of war. This Committee has held several meetings, and has prepared a report, which is summarised below.

In stating that the programme for the 1916–17 session is now in preparation, the Council call attention to the need for further support, or an increase in the subscription rates, which admittedly are moderate.

The Chairman, in placing the report before the meeting, said the Society had eminently justified its existence in having mainly by its activities brought about a recognition on the part of the Government of the necessity for doing what the Society

was created to do, viz., see that lighting when it was attempted was good.

Mr. F. W. Goodenough, who formally moved the adoption of the report, called attention to the paragraph in the report which pointed out that on the financial side the Society was feeling the strain of the war. It could only be hoped that some of the undertakings which provided illuminants would be able to see their way to recognise in some manner the good work the Society had done in helping to bring about and to give publicity to the report of the Home Office Committee on factory lighting, because the action of the Government in stipulating for good lighting in factories and workshops was bound to have a beneficial effect upon the suppliers of the illuminant, and the work of the Society might very well be recognised in that direction.

Mr. O. P. McFarlane seconded, and the report was adopted.

Report of Research Committee.

The following is an abstract of the interim report of the Committee on Research :—

The appointment of this Committee was announced at the end of the session in 1914, but owing to the disturbance caused by the war it was not found practicable at that time for the Committee to take up the tasks before it. The present moment, when so much attention is being devoted to the promotion of scientific and industrial research, appears favourable for the resumption of the work. An important step has been the appointment of a Committee of the Privy Council in order to study the organisation of scientific and industrial research, and the Royal Society and other bodies are considering the best means of promoting unity of effort between the various scientific and technical societies of the country.

The following gentlemen have at present been nominated to serve on the Committee :—Messrs. A. Blok, J. G. Clark, W. C. Clinton, J. F. Crowley, F. W. Goodenough, S. R. Mullard, C. C. Paterson, A. P. Trotter, F. W. Willcox, Lieut. Haydn T. Harrison, R.N., Dr. James Kerr, Professor T. Mather, Professor J. T. Morris, Professor Silvanus P. Thompson (Chairman), *ex officio* Mr. L. Gaster (Hon. Secretary) and Mr. J. S. Dow (Asst. Hon. Secretary).

The immediate object of the Committee was to prepare a list of subjects specially deserving of research at the hands of the Society, and a large number of suggestion are now under consideration. The Committee will welcome any additional suggestions, or intimations from members of any experiments which are already in progress.

In dealing with these and future suggestions the Committee may nominate from among its members sub-committees to organise or undertake specific researches or may take advantage of the services of other members of the Society, or gentlemen outside the Society, who have special knowledge of the proposed researches. Some of the investigations in contemplation will involve co-operation with other Societies and Institutions. In connection with subjects of importance from the industrial standpoint the Committee suggest that priority should be given to investigations relating to the development of lamps and lighting appliances, and researches having for their object the elucidation of general problems on which the development of the lighting industry depends. As an instance, the investigation of the properties of illuminating glassware is a matter which, in the opinion of the Committee, should receive immediate attention at the hands of a special sub-committee appointed for the purpose.

Another subject which merits early attention, in view of its relation to the dyeing and colouring industries, is the preparation of a standard series of colours and in particular of a standard white surface, suitable for acceptance in all researches in which the accurate definition of colour is involved. Conjointly with this subject the design of suitable apparatus for analysing and specifying colour and for measuring the reflecting power of various materials should receive attention. There is also the further problem of providing a fixed standard for the permanence of coloured materials.

In view of the growing recognition of the need for precise quantitative specifications of illumination required in practice for different purposes, the preparation of a standard specification for illumination photometers, to be used in determining the performance of legal contracts involving the measurement of illumination, might be studied with advantage. The general question of the simplification of illumination photometers, and particularly the problem of producing a direct-reading instrument based on physical or chemical effects, should also be borne in mind.

Among other matters which, in view of their important bearing on the future development of lighting, deserve special attention, may be mentioned : the study of glare and the limits of permissible intrinsic brilliancy; the investigation of the comparative effect on vision and the physiological influence in inducing fatigue of natural and artificial illumination and of various systems of artificial lighting; and the conditions, as regards the intensity of illumination and arrangement of lights, desirable for various industrial operations. The latter question is of interest as being supplementary to the report of the Home Office Departmental Committee on Lighting in Factories and Workshops, and it is suggested that the preparation of an illustrated bulletin forming a guide to the best present practice in various sections of industrial lighting might be undertaken.

In the list of researches the various suggestions have been roughly classified under the following headings :—

(*a*) Photometry, Standards of Light, and Researches on Colour.
(*b*) Electric, Gas, and other illuminants.
(*c*) Lighting Appliances.
(*d*) General.

"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published May 11th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

4,263/15. **Transformer Tanks.** Babcock & Wilcox, Ltd. (*Babcock & Wilcox Co., U.S.A.*). Tanks for oil-immersed transformers and other apparatus constructed to dissipate heat by circulation of the liquid through flattened tubes let into the wall of the tank. (Four figures.)

5,918/15. **Surge Prevention.** B.T.-H. Co. (*G.E. Co., U.S.A.*) The construction of electrical apparatus in which resonance is liable to occur with different sections of the winding with materially different natural frequences to restrain the building up of dangerous voltages. (Three figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Scholes [Junction box] 10,026/15.

Dynamos, Motors and Transformers: British Electric Transformer Co. and McWilliam [Oil-cooled transformers] 8,107/15.

Ignition: Payne [Magnetos] 9,519/15

Telephony and Telegraphy: Naamlooze Vennootschap de Nederlandshe Thermo-Telephoon Maatschappij [Thermic telephones] 5,832–5,840; 5,842–5,847/15; Van Lyden and Naamlooze Vennootschap, &c. [Thermic telephones] 6,586/15.

Miscellaneous: Svenska Turbinfabriks Aktiebolaget Ljungstrom [Electric marine propulsion] 7,092/15; Cassel [Winding devices for trailing cables] 9,635/15; Westwood [Cycle lamp switch] 16,780/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Arc Lamps: Sperry [Search lights] 12,999/15.
Storage Batteries: Crowdus, 5,570/16 (*100,315*).

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps, &c.: Deutsche Beck Bogenlampen Ges. [Flame electrodes] 11,979/07.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: E. S. Seymour and E. A. Claremont [Machine for covering cable with paper] 1,848/04.

Dynamos, Motors and Transformers: B.T.-H. Co., (*G.E. Co., U.S.A.*) [Brush holders for gearless traction motors] 2,138/07.

Electrochemistry Instruments, &c.: W. B. Duddell [Vibration Galvanometers] 1,779/08.

Telephony and Telegraphy: E. A. Graham [Current supply for telephones] 1,714/06; E. Belin [Facsimile telegraphs] 1,615 and 16,272/08.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,494.

It is desired to work a number of centrifugal fans by three-phase 50-cycle induction motors which have squirrel-cage rotors. The speeds of the fans vary from 1,400 to 1,700 r.p.m. It would be an advantage if the motors could be coupled direct and the frequency raised to 60, according to requirements for each motor; failing this, what is the best way to obtain the speed variation economically? The supply is from the corporation at 200 volts.—"SPEED."

(*Replies must be received by first post Thursday, May 25th.*)

ANSWERS TO No. 1,492.

After repairing a joint box of a three-phase cable feeding overhead lines at 3,000 volts, the insulation of the three conductors (cable and line connected together) was 6 megohms, 10 megohms, and 12 megohms respectively. At the other end of the lines is a three-phase lighting transformer, the insulation of which, tested separately, was 20 megohms. On repeating the test with transformer across the line, an insulation resistance of 1·5 megohms was obtained. The testing instrument was a "megger" in all cases. What is the explanation?—T. G. E.

The first award (10s.) is given to "J. N.," who writes:—

It is obvious, in the first case, that the resistance to earth on four separate conductors were taken separately. In the second case, by putting the transformer in circuit, the three lines would be connected in parallel with the transformer, so that by taking the insulation reading on one of the lines it would be equivalent to taking an insulation to earth on three lines, plus the transformer in parallel. This should give 2·5 megohms, whereas the reading, I notice, is only 1·5 megohms. Possibly the low reading is due to the megger not being turned long enough to charge the cable up, as the increased capacity of the three lines, cable, and transformer in parallel would take a little longer time to charge.

The second award is given to "L. R." We give his reply below, slightly abridged:—

The second test gives the resistances of 6 megohms, 10 megohms, 12 megohms, and 20 megohms in parallel, and the combined resistance will be

$$1/(\tfrac{1}{6} + \tfrac{1}{10} + \tfrac{1}{12} + \tfrac{1}{20}) = 2{\cdot}5 \text{ megohms.}$$

Now, the measured resistance was only 1·5 megohms as against the expected 2·5. Most of the more or less obvious suggestions to account for the difference disappear, because they would deal with moisture, defective filling of joint-box, and so on, and such would have affected the readings for the single conductors. It is therefore clear that it is due to something brought into play by the assembling or connecting up of the system, and this is to be found in the capacity of the assemblage.

It is not stated what type of megger was used, and this is material, but from the result I imagine the hand-controlled type, as distinguished from the constant-speed type, was used. Wherever capacity is likely to be present, the latter type must be employed, or erratic results will be secured. With the former type it is really only the current coil that is affected by the capacity current, so it is clearly most difficult to use it where capacity is present.

Neither of these two competitors, nor the others who have sent in their replies, point out that from 6 to 12 megohms is a fairly high insulation resistance for a long overhead line. It is possible, therefore, that this test was taken in very fine weather, and the second test in less favourable weather, when the insulation resistance of the line was lower.

ANSWERS TO CORRESPONDENTS

CONVERTER.—Your figure of 17·3 volts per segment is correct. With regard to the latter part of your query, we suggest that you should draw a winding diagram; this will probably show that the number of segments you propose is unsuitable.

DIESEL ENGINE USERS' ASSOCIATION

AT the May meeting of the Diesel Engine Users' Association a further discussion took place on the accident to a Diesel engine air compressor at Smithfield Markets (see ELECTRICAL ENGINEERING, April 27th, p. 148). Mr. R. L. Quertier, the London manager of Messrs. Reavell & Co., Ltd., who attended the meeting by invitation, made some remarks on behalf of his firm, who are the makers of the air compressor concerned. His firm's theory was as follows:—The high-pressure valves were not functioning, with the result that there was more or less open passage connection between the final delivery pipe to the blast bottle and the intermediate purge pot. The valve between the blast bottle and the compressor was opened just before the accident, and this would allow the dense air in the blast bottle to rush back along the pipes to the intermediate purge pot by way of the high-pressure cylinder. They suggested that the velocity at which the rush took place and the density of air caused it to lick up and carry away any oil deposited on the pipes and to churn this into a fog. The intermediate relief valve, as tests recently made proved, is capable of dealing with all the air aspired by the compressor with a rise in pressure of not more than 30 lbs. per square inch, but it was obviously incapable of dealing with an almost instantaneous rush of air from the blast bottle, and consequently the pressure rose till a balance was obtained. All the while, of course, the intermediate cylinder was delivering air, and had now to compress against this greatly increased pressure, so that the temperature of the delivered air rapidly increased till it was sufficiently hot to ignite the oil mist in the purge pot and cooling pipes. It was not necessary for this rush back of air to take place immediately the blast bottle valve was opened, because the compressor was at work, and the conditions necessary, that is a more or less free passage into the I.P. purge pot and coils, may not have been immediately present. Again the same conditions would be obtained with a slower leak back if for any reason the I.P. relief valve were not in its proper working order. If this theory be the correct explanation of the explosion, it was clear that the greatest safeguard possible would be a back pressure valve inserted in the final delivery pipe between the blast bottle valve and compressor. Mr. Quertier thought that this valve should be fitted close to the blast bottle end of the pipe, as there the air pulsation would be less definite and the air would be cooler. These conditions would ensure the valve working freely without undue wear or tendency to stick.

The next meeting of the Association will be held on Friday, June 23rd, when Mr. George E. Windeler will read a Paper on the subject of "Methods of lubrication and the difficulties of efficiently lubricating a Diesel engine."

Electric Supply and Fire Risk.—The National Board of Fire Underwriters of Chicago has issued its "1915 National Electrical Code," which contains the regulations for electric wiring and apparatus as recommended by the National Fire Protection Association. A few copies of the code are available for distribution to United Kingdom manufacturers of electrical apparatus, and they may be obtained on application to the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C. This code has been adopted by the Canadian Fire Underwriters' Association, and British firms are notified of the necessity for complying with the regulations of the code before undertaking the sale of their goods in the Dominion of Canada.

Obituary.—Many of our readers will join us in feelings of sympathy with Mr. C. H. Wordingham in the loss of his mother, who passed away on May 11th. A constant companion of her devoted son, Mrs. Wordingham was known and respected by many of the electrical fraternity, who looked forward to meeting her at the Institution conversaziones.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

We have now received from the Engineer-in-Chief of the G.P.O. a descriptive account, prepared by Mr. J. Hedley, of the new automatic exchange at Portsmouth. We gave some particulars of this exchange in our issue of May 4th, p. 161. Automatic exchange working for public service was first introduced in this country in 1912, when the Epsom exchange was opened with a capacity of 500 lines, and since that date exchanges have been opened at Hereford (500 lines) and Darlington (800 lines) in 1914, and Accrington (700 lines), Chepstow (65 lines), and Newport (Mon.) (2,000 lines) in 1915. Equipment for 5,200 lines has been provided at Portsmouth, which exceeds the total equipment of all the previous exchanges, and embodies the latest developments in automatic telephone exchange working. Some of these are as follows :—

(1) Facilities are available on primary line switch units for cross-connecting subscribers' lines to any line switch, thus affording means for distributing the originating traffic equally throughout the exchange. (2) Secondary line switches are fitted between the primary line switches and first selectors, to enable the originating traffic from each group of 100 subscribers to be spread over a larger group of selectors. Each of the trunks outgoing from the primary line switches are distributed among different groups of secondary line switches, each such group having access to 10 first selectors. This scheme provides for the distribution of the traffic more uniformly over the entire exchange, and so affords better traffic conditions. (3) When the called subscriber is engaged, a "busy back" tone is given to the originating subscriber; if the engaged subscriber is called from the manual board, a "busy" flash signal is transmitted to the operator's cord circuit. (4) When a called subscriber replies, the ringing current is tripped immediately. (5) The number of routes incoming to any unit can be varied without altering the permanent wiring. Increases in load incoming to any unit can thus be dealt with by merely inserting a connector switch on one of the spare multiple banks provided. (6) The meter of the originating subscriber is operated for completed calls between two automatic subscribers only. The meters are mounted on racks in such a position that the records are readable from the manual switch-room. (7) In the case of trunk and junction calls *viâ* the manual board, talking current is supplied to the subscriber's telephone direct from the manual board cord circuit, thus improving transmission. In order to effect this, the connector circuit is arranged to switch the feeding coils of the automatic plant, out of circuit when the subscriber replies. (8) A two-party line automatic service is afforded. The X subscriber's bell is joined to A line, and the Y subscriber to the B line. The latter subscriber is rung by a reversal of the ringing on the connector switch. (9) The operators at the outlying manual exchanges "dial" the Portsmouth subscribers direct over the junction circuits; standard supervision is afforded to the sub-exchange operator. (10) Each switch, and the outgoing and incoming routes for each switch, are so designated as to enable calls to be traced backwards or forwards to the next switch without difficulty. (11) An alarm circuit is extended to the manual board during the night and on Sundays, when no engineering staff is on duty in the automatic exchange. The alarm is associated only with those circuits which actually affect the working of the exchange, such as fuses blown and failure of ringing. (12) The master switch controlling the line switches associated with each primary and secondary line switch unit can be removed without displacing the line switches.

The automatic equipment is fitted on the second floor of the head post office. The underground cables are led *viâ* a large cable chamber and chute to the main frame, on which fuses for 8,000 circuits are provided. The lines are then cross-connected to the protector side of the main frame according to the numbers allocated to the subscribers. Permanent switchboard cabling is provided between the subscribers' protectors and the primary line switch units.

The power plant consists of a power board, two motor-generators, two ringing machines, and two sets of accumulators of the Electrical Power & Storage Co.'s type, with a capacity of 986 ampere-hours at the 9-hour rate of discharge. The machines are of the shunt-wound type, with an output of 225 amps. at 35 volts, and were manufactured by Messrs. Crompton and Co. (Chelmsford). Each motor-generator has eight isolating devices fitted underneath; these were found to be necessary to overcome noise transmitted to the structure from the A.C. machines. These devices were installed by Messrs. Christie, Grey & Co. (Lloyds Avenue, London), and have proved to be satisfactory. The whole of the automatic plant has been manufactured and installed by the Automatic Telephone Manufacturing Co., Ltd. (Liverpool), according to a specification prepared by the Engineer-in-Chief to the Post Office (Sir William Slingo), and from the results of the working of the exchange and the satisfactory reports received from subscribers, the transfer from manual to automatic service is claimed to be a complete success.

An interesting paragraph with regard to an attempt by the Irish rebels to seize the Marconi wireless telegraph station at Skerries, County Dublin, was given on Friday by the Dublin correspondent of the *Daily Telegraph.* It appears that on Easter Tuesday the local police got word of an attempted attack on the station and, although there was only a small military force available, every precaution was made to meet the attack. On Wednesday the rebels captured the villages of Swords and Donabate, and tried to blow up the Great Northern railway line. Then they prepared to march on Skerries. The villagers gathered on hills to watch the battle for the station. Just then a destroyer came along at a great pace, and landed 200 men of the South Staffordshire Regiment, who at once entrenched themselves around the station. Their arrival saved the station, for the rebels, on learning of the presence of the destroyer, wheeled about and went off in the direction of Dublin.

ELECTRIC TRACTION NOTES

Some notes on the methods adopted of overcoming difficulties in the early operation of the Philadelphia-Paoli section of the Pennsylvania Railroad (see Electrical Engineering, Dec. 23rd, p. 507) are given in the *Electric Railway Journal.* Current is conveyed to the trains at 11,000 volts by overhead wires. Between West Philadelphia and Paoli there is a large number of overhead bridges, of which several clear the top of track lines by not more than 17 ft. The transmission lines, as well as the catenary system, pass under these bridges, and, as originally installed, were carried on post-type insulators made up of three 8-in. porcelain discs cemented into malleable iron caps in series. In the typical highway-bridge overhead construction, these post-type insulators were mounted on I-beams attached to the bridge structure. The insulators carried at the lower end impregnated wood sticks to which were fastened the messenger and contact wires. These insulators on dry flashover test withstood 175,000 volts, and on rain test 90,000 volts. The territory included within the Paoli electrification, however, handles a very heavy steam traffic, the smoke and steam conditions under the bridges being very severe. As a result of these conditions, the insulators and wood sticks quickly became covered with a soot deposit, and evidence of leakage from the live circuits to the base of the insulators soon made its appearance. At certain bridges, where the conditions of clearance and volume of steam traffic handled were least favourable, a number of insulator flashovers occurred, many of these cases being coincident with the passing of heavy steam trains under the bridges. Cleaning of these insulators met with indifferent success, and it was finally decided to replace them with others having greater creepage distance. The insulator selected is of a special type with two large petticoats, one of 13 in. diameter and the other of 12¼ in. diameter. As applied to the particular purpose under discussion, two of these insulators are mounted in series. A few installations were made where two combination units were mounted on the bridge structure, one at either side of the track centre line supporting a piece of pipe to which the catenary structure was fastened. The arrangement commonly employed, however, involves the use of one combination unit per support per track, located directly above the centre line of the track, and carrying the messengers and contact wires. Both of these last-mentioned installations have proved very successful, and no failures have occurred to date.

A dividend of 3 per cent. is recommended on the new ordinary stock by the British Electric Traction for the year ended March 31st.

The accounts of the damage done to the Dublin tramways system during the rebellion were exaggerated, as by the end of last week the power station and the distributing station were virtually working normally. Some damage was done to the rolling stock, as some of the cars were seized by the rebels to form street barricades.

ECONOMIC WAR

IN an address given to an engineering industry meeting in Glasgow on Tuesday, Mr. T. C. Elder (British Electrical and Allied Manufacturers' Association), dealt with some aspects of the international industrial contest which was being waged before the military war, and would recur afterwards. It cannot be too often repeated, he said, that the struggle is a war between whole nations, and not simply a trial of strength on the battlefield. Such a competition cannot be brought to a close just because a number of statesmen and soldiers agree upon military and political terms of peace. The chain of historical causation is continuous, and although our immediate aim is to smash German militarism, it will be necessary to go beyond that objective and to establish safeguards against the recrudescence of Germany's former economic policy. Her military and her industrial system, he continued, have both been designed for the same purpose—for rapidly achieving power and prosperity at the expense of her neighbours, and she has been restrained by no scruples of any description. It will be a case of war's labours lost if the Allies do not settle upon some method of preventing Germany from resuming business as usual; but it is not necessary to talk about putting Germany out of business altogether. The aim of the Allies should be to impose on the German people a fine which as a national debt will rank in priority to the war loans that are reported to be raised with such marvellous ease, but which may not be so conveniently redeemed; and in addition to this fine or indemnity, the measures taken by the Allies should amount in effect to the condemnation of the German people to a term of hard labour in the sense that it would practically be dictated as to what kind of industry would be permitted, or at any rate what kind would not be permitted. That would mean that there will be no arsenals in Germany, and little manufacturing of a kind which indirectly ministers to military power. The great bulk of the population should certainly be confined to agricultural occupations and what we will call harmless manufacturing. Germany relied on dissension and disorganisation before the war. She also believes that the trade of this country will still be governed by mercantile and financial rather than by manufacturing considerations in our estimates of prosperity. The first question that should be discussed at any economic conference of the Allies is how Germany may be kept permanently disarmed and disabled; and there is no hope whatever of doing that if she is permitted to be again a sort of mechanical and chemical universal provider for Europe and other parts of the world. Our object is to keep Germans occupied with labours that cannot be turned to frightfulness.

There is a natural reluctance to resume the wearisome debate touching Free Trade and Protection if it can be avoided. There are theoretical and practical objections to both these fiscal principles if it is a question of their general application. But the war has sharply reminded us of the need for discrimination and selection in our ways of earning our national livelihood, and the country is ready to accept in place of all-round Free Trade or Protection some rational system of public encouragement for those trades that appear to be of most vital importance. The idea of industrial preference suggests first consideration for three groups: the agricultural, the textile, and the engineering, which includes shipbuilding. What we are concerned with is the engineering group.

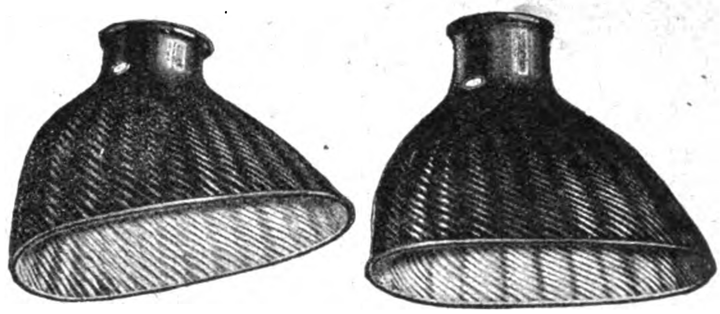
National and Imperial safety depends on the maintenance of a progressive and prosperous engineering industry, and we cannot again take the risk of allowing Germany to attain mechanical military superiority on land or sea, or under the sea, or in the air. Engineering is in peace also the key industry. If we keep Great Britain a well-engineered country we are going far to ensure that it will be a well-populated, a well-capitalised, and a well-employed country. Free Trade in engineering, he said, must go for ever. To go on employing Germany to make machinery for us; to allow her syndicates to corner our metal supplies; to give her equal opportunities of developing her engineering and shipbuilding as though these were purely peaceful industries, would be a political crime.

The Board of Trade has recently appointed committees of inquiry to report on the future of the engineering and other groups of industries. What these committees have to report on is, in reality, the prospects of employment for millions of our people. The question is broadly how we are going to live after the war. It seems to me, Mr. Elder continued, a gross blunder to refer the future prospects and conduct of this salvation industry to a small group of company directors. Here was a magnificent opportunity for bringing together representatives of the board room and the workshop to discuss their common interest in industrial progress. While trade unionists are naturally interested in wages and manufacturers in profits, they stand on common ground when national policy is under discussion, touching the right method of maintaining the flow of revenue out of which alone these demands of capital and labour can be met. In another direction the manufacturers must show more breadth of mind. They must be readier to discuss common interests with their competitors, and they must associate and organise so that Germanic and American business leagues may be met and withstood in the great markets of the world. Some concentration of manufacturing interests is imperatively required to act on the general behalf of productive industry. The solitary British manufacturer seeking business abroad, in the face of competition supported and subsidised by the diplomacy and the finances of the German Empire, has often been sorely in need of a powerful organisation of this kind. Such an association is now in course of construction, on the most solid foundations, and if as an executive machine it can be used to further the national business purposes so frequently enumerated by the chambers of commerce and other industrial bodies, the effect should be to remove many obstacles to the advancement of our Imperial economic interests.

SPECIAL X-RAY REFLECTORS FOR HALF-WATT LAMPS

A WORD of warning is necessary to all users of X-ray direct lighting reflectors, in view of the recent additions to the range of half-watt lamps available. Those who have already experienced the benefits of brilliant and economical lighting, using ordinary metal filament lamps in X-ray reflectors, are advised not to be tempted to economise still further by simply putting Mazda half-watt lamps in place of the lamps at present used, for the heat of the half-watt lamp would destroy the enamelled silver backing of the ordinary X-ray reflector and render it useless.

To permit advantage to be taken of the well-known merits of the X-ray lighting system, when using half-watt lamps for the direct lighting of shop windows or other interiors, the British Thomson-Houston Co. (Mazda House, 77 Upper Thames Street, London, E.C.) have developed three new reflectors for use with Mazda half-watt lamps, two of which are illustrated. These reflectors embody the same merits as the ordinary X-ray reflector in respect of scientific design, freedom from striation and permanently high reflecting efficiency. The distinctive feature of the new patterns is the provision of a special backing to withstand the high temperature of half-watt lamps.



"JOVE" TYPE FOR LOW WINDOWS. "JUPITER" TYPE FOR HIGH WINDOWS.

X-RAY SILVERED GLASS REFLECTORS FOR MAZDA HALF-WATT LAMPS FOR WINDOW LIGHTING.

The "Jove" X-ray reflector, which is very similar in appearance to the "Scoop" type, is intended for use with 100-watt Mazda half-watt lamps, and is suitable for windows of average proportions. It throws an equal amount of light back and down, which distribution is suitable for windows from 1 to 1½ times as high as they are deep. If the window height be about twice as great as its depth (measured from the front glass to the background), the "Jupiter" X-ray reflector, in conjunction with a 100-watt Mazda half-watt lamp, throws a powerful beam of light downwards and thus meets the needs of the case. In general appearance the "Jupiter" reflector much resembles the "Helmet" pattern of ordinary X-ray reflector.

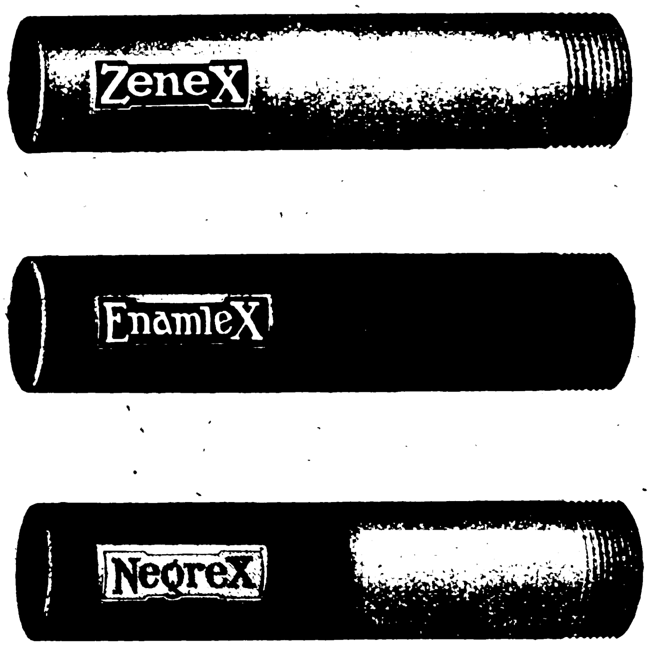
The "Jumbo" reflector, for use with 500, 750, or 1,000-watt half-watt lamps, is altogether a unique production. It is the largest one-piece glass reflector ever blown (16½ in. diameter, 13¾ in. high), and is particularly suitable for the efficient direct illumination of very large interiors. This reflector requires a special metal hanger, at the top of which a special holder can be supplied with an adjustable feature which makes it possible to obtain two or three degrees of spread to the light.

War Tribunals.—In dealing with an application for the exemption of the electrician, wireman, and spare part maker at the Worthing Cinema, a single man aged 27, the military representative said that a wireman was no longer an exempted occupation, and as recruits were wanted for the Royal Engineers, this type of man was the very one required. As the man had already had three months' exemption the appeal was dismissed. —The manager of a Southport firm of Electrical Engineers who are employed in carrying out Government sub-contracts appealed for absolute exemption last week, but the tribunal decided not to deal with the application; the man is at present holding a badge.—An electrician, 32 years of age, married, applied for exemption on business grounds. As he had contracts to complete exemption was granted until July 10th.

CORROSION PROOF CONDUIT

A NEW booklet to hand from the Simplex Conduits, Ltd. (Garrison Lane, Birmingham), dealing with the protective covering of conduits, describes in some technical detail a new pure zinc covering, to which the registered name of "Zenex" has been given, and to the pure zinc finish subsequently treated with enamel, to which the name of "Negrex" is applied. Ten years ago this Company carried out very extensive trials and experiments in connection with this matter, and in 1907 published a booklet on the "Protective Covering of Conduits," dealing with the preparation of their surfaces and the method of applying the enamel covering, and stoving it in order to secure a flexible, acid-resisting, and protective covering. Under the most advantageous circumstances, however, an enamel covering can only afford protection in proportion to its adhesive property, and so long as it is intact and kept free from mechanical damage.

It is a well-known fact that pure zinc forms the surest protection for iron and steel surfaces, and the nearest approach to this in the past has been by the hot galvanising process, which has certain disadvantages for the purpose in question. Simplex



"SIMPLEX" CONDUITS.

Conduits, Ltd., have recently installed at their Birmingham Works what is probably the largest automatic plant in the kingdom for dealing with the deposition of pure zinc on the surfaces of steel conduits, and all tubing treated by this process is known by the registered name of "Zenex," as distinct from the enamelled process known by the trade name of "Enamlex." Although "Zenex" finish affords the surest protection to steel conduit, it is itself attacked by acids, and consequently it is recognised that in certain situations a further protection is requisite for the pure zinc covering. This is arranged for after special treatment by a flexible, acid-resisting enamel, and to conduits treated in this manner the registered name of "Negrex" has been applied.

In both the "Negrex" and the "Zenex" finishes the interior surfaces of the conduit—which are not exposed to the same corrosive influences as the exterior surfaces—are treated with a high grade of flexible enamel, and this internal enamelling is carried out by a new improved process which ensures there being an homogeneous and continuous coating throughout.

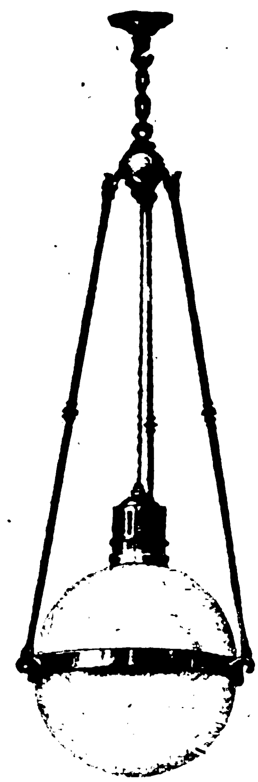
CATALOGUES, PAMPHLETS, &c., RECEIVED

MAZDA LAMPS.—A list to hand from the British Thomson-Houston Co. (Mazda House, 77 Upper Thames Street, London, E.C.) gives prices, etc., of all the various types of Mazda lamps, including half-watt lamps, candle lamps, tubular lamps, etc. A characteristic light distribution curve in vertical plane is included.

Winding up Enemy Firms.—Among the list of enemy firms which the Board of Trade ordered to be wound up last week were The Wolf Safety Lamp Company, Boston Street, Sheffield, makers of miners' electric lamps, and E. M. Brinckman and Company, 99 Redcross Street, Southwark, dealers in electric lamps, batteries, etc

"VERILUX"

A LONG list might be made of the various devices which have been designed and tested to provide artificial illumination which will be equivalent to daylight. Until recently the best results were obtained by the use of arc lamps, preferably on the inverted principle, but the gradual disappearance of the arc lamp in favour of the metal filament lamp has forced attention to the problem from a somewhat different point of view, viz., by the treatment of the lamp and its globe as twin factors in producing a definite illuminating result. Previous efforts towards daylight illumination were directed mainly to the treatment of the light source.



"VERILUX" PENDANT.

It is on this basis that "Verilux" glass has been invented. This is the new three-ply glass recently placed on the market by the General Electric Co. (67 Queen Victoria Street, London, E.C.). The inmost layer is a colour-straining medium, the next is a diffusing medium, and the outside layer is of clear glass to provide the necessary "body" or strength. Light transmitted through this glass emerges as a precise imitation of daylight, and it is free from glare. There is no restriction on the shape or dimensions of the globes made for this purpose, but of course the best results are obtained with the deep bowl or the spherical types, which ensure that practically all the rays are transmitted through the glass.

There are many industries which, for want of such an invention, can be carried on for only a few hours each day during the winter months. Apart from the enormous retail business in coloured fabrics, there are the wholesale trade, the textile manufacturing industry, dye-works, chemical factories, paper works, printing works, and a host of others where a daylight effect is invaluable. Again, in picture galleries, museums, studios, and every industry connected with the fine arts, artificial daylight is obviously a boon. It may be mentioned that "Verilux" was recently tested in an art gallery with excellent results. In domestic and office lighting there is also a field which is worth cultivating.

Institution of Electrical Engineers.—The following is the result of the ballot for the election of new members, and for transfers from one class to another, at the annual general meeting last Thursday :—

Associate Members.—J. C. de Wardt, T. W. Jeffreys, G. Moores, W. G. Newberry, C. H. Nicholson, C. A. Powel, Capt. F. N. Shumaker, R.F.C., Sec.-Lieut. C. Singleton, R.E. (T.), L. T. Wakeford, E. S. White, C. T. Arnett, N. Cresswell, H. A. Eastman, J. V. Gil, W. H. Hart, G. B. Hebden, J. H. Sandiford, F. P. Spicer, F. E. Thrupp.

Graduates.—W. J. Furness, C. E. Jones, R. P. Jones, C. K. Chandler, H. S. Fellowes, T. Gladdy, K. J. Kirkpatrick, H. G. Mowbray-Hafner, V. A. Pask, H. B. Saxby, H. H. Tilley.

Students.—F. N. Baker, H. T. Body, L. S. Lloyd, C. J. Payne, M. F. Plowman, W. A. Ravn, C. E. Warner, K. F. Hilder.

Candidates Transferred from Associate Member to Member.—W. Browning, H. T. Wilkinson, A. F. Atchison, H. Cooper, A. E. Ridgway.

From Graduate to Associate Member.—V. A. Bright, D. Little, A. McIntosh, A. J. Ramsay, E. F. Turner, L. E. Wood.

From Student to Associate Member.—A. S. Carr, Sec.-Lieut. W. G. Edward, R.E. (T.), R. A. Mack, E. W. Sleight, W. A. Woodrow, B. C. Clayton, A. W. Crompton, W. Inglis, C. E. Maguire, A. Stubbs.

From Student to Graduate.—R. de Hollanda, T. H. Hall, R. F. Maidment, B. G. Spendiff, C. J. Alsford, H. J. Tolley.

Manchester Summer Evening Technical Classes.—The summer evening classes of the Manchester Municipal School of Technology commenced on Monday. The lectures in the electrical engineering course include "The Curing of Defects in Electrical Machinery"; "Measurement of Power and Energy in Single-phase and Polyphase Circuits"; "Wave Forms"; "Examination of the Magnetic Properties of Iron"; "Insulation and Insulation Testing"; "Electrical Railway Practice in America."

LOCAL NOTES

Accrington: *Loss on Electricity Undertaking.*—In reporting a loss of £3,410 on the electricity undertaking last year, following a loss of £3,670 in the provious year, the Chairman of the Electricity Committee said that the Department is losing money on contracts made before the war. There was, however, every prospect that the finances would improve considerably during the coming year. At the same time, if the Daylight Saving Bill came into operation, they would lose about 10 per cent. of their income during the summer.

Belfast: *Electrical Contractors and New Consumers.*—A short time ago the Corporation decided, owing to difficulties in obtaining loans for mains and services, to refuse to connect up new consumers except where the supply was necessary for the purpose of the war. This decision, of course, has not been without its effect upon the wiring industry in Belfast, and last week a deputation from the Ulster branch of the Electrical Contractors' Association waited upon the Tramways and Electricity Committee to urge the desirability of proceeding at once for the development of the electricity undertaking in the usual way in order to meet the increasing demands upon it. The Committee promised to take the matter into consideration.

Belfast: *Electricity Accounts.*—The accounts of the electricity undertaking for last year show a net profit of £17,000, a record for the department, the previous best being £13,175 in 1913-14. Here, again, the greater portion of the increased demand is due to the use of energy for power purposes. Having regard to the controversy which has centred around the Belfast electricity undertaking for so long, particularly as regards its management, the result of last year's increase is particularly significant and satisfactory.

City of London: *Electricity Charges.*—The proposal of the Charing Cross, West End and City Electricity Supply Co. to increase their statutory charges during the war was inquired into by the Board of Trade last week. As we have already noted, the City Corporation opposed, and, in addition, the L.C.C., the Port of London Authority, and some thirty private consumers also appeared in opposition.

Greenock: *New Plant.*—A new 5,000-kilowatt Westinghouse-Rateau steam-turbo generating set has just been put into operation. This is a duplicate of the one installed two years ago in connection with the supply to Port Glasgow. This latest set, however, has been rendered necessary in order to meet the normal development of the undertaking, which is going on at a very rapid rate. It is anticipated that the output at the end of the present financial year will reach 20,000,000 units.

Middlesbrough: *Increase in Bulk Supply Charges.*—The Cleveland & County Electric Power Co. have notified the Corporation that, owing to the increased cost of coal and the unavoidable rise in charges and cost of stores, it has become necessary to increase the charge for bulk supply of electricity by 15 per cent. as from January 1st, 1916. This increase it is proposed to retain until six months after the war. The Electricity Committee is investigating the whole question, and will report shortly.

West Hartlepool: *Electricity Accounts.*—There was a deficit of £343 on the working of the electricity undertaking last year, but this result has been brought about by charging to revenue a number of items which, in normal times, would have been defrayed out of loans, including a large sum in respect of depreciation of motors and stores relating to previous years. Leaving these out, there was an actual profit of £316. The revenue showed an increase of £1,295, principally from large power users.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Accrington.—The sanction has been given to loans of £7,000 for a new chimney, boiler, &c., and £14,000 for new generating plant, cooling tower, boiler, and feed-pumps.

Carlisle.—Cable estimated to cost £370 is to be laid for the purpose of supplying the L. & N.W. Railway Co.'s new locomotive sheds, the coaling plant of which is to be driven electrically.

London: *Hammersmith.*—The Finance Committee of the L.C.C. recommends sanction to a loan of £3,000 for mains, transformers, switchgear, and house services. the respective periods for repayment being 25 years, 15 years, 15 years, and 12 years.

Hampstead.—The Finance Committee of the L.C.C. recommends sanction to a loan of £3,000 for a switchboard.

Middlesbrough.—Cables are to be laid to supply current to a large local works.

New Zealand.—The Pahiatua Borough Council requires gas-driven generating plant, overhead wires, street lamps, accumulators, &c. Tenders to Town Clerk by July 10th. The specification with regard to the street-lighting plant may be seen at 73 Basinghall Street, E.C.

Wolverhampton.—The Local Government Board has sanctioned £4,600 for mains and £2,000 for sub-station equipment.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. Wiring contractors are recommended to make inquiries to ascertain whether electrical work will be required.

Keighley.—Wiring of the Fever Hospital and Sanatorium at Morton Banks. Borough Electrical Engineer. May 22nd.

Miscellaneous

Australia.—The Sydney Municipal Council requires a two-ton electric lorry. Tenders to Town Clerk, Town Hall, by June 20th . The specifications can be consulted at 73, Basinghall Street, E.C., but this notice will only be of use to firms who can cableagents.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £150 to £156 (last week, £155 to £161).

Plant for Sale.—The Leeds Electricity Department has a quantity of plant for sale. (See an advertisement on another page.)

Agencies.—A firm in Johannesburg wishes to obtain agencies covering the Transvaal, Natal and Rhodesia for British manufacturers of high tension oil break switches and switchgear, motors, transformers, electricity meters of all descriptions, and electric mine-signalling apparatus (such as bells, pulls and pushers).

Manufacturers of the goods mentioned are requested to apply to the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

APPOINTMENTS AND PERSONAL NOTES

The Eastbourne Electricity Department requires a Mains Engineer. (See an advertisement on another page.)

The salary of E. Andrews, junior assistant at the Barnsley Electricity Works, has been increased from £117 to £125 per annum.

Mr. H. W. Couzens has been appointed Consulting Electrical Engineer to the Bethnal Green Borough Council until March, 1920, at an annual fee of 200 guineas, plus 5 per cent. commission on capital expenditure upon plant and mains.

South Metropolitan Electric Light and Power Co.—In order to provide for the continuous expansion of the business the shareholders are being offered a further £30,000 of 4½ per cent. First Mortgage Debenture stock at £85. The stock will rank *pari passu* with the other 4½ per cent. Debenture stock of the company, and will be repayable at par on July 1st, 1931, or earlier at the company's option on six months' notice, at the price of £110 per cent. Allowing for redemption, the return to an investor at the price of issue is about 6 per cent. per annum.

TRADES DIRECTORY OF ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardift.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Poulton Bros., Ltd., 38 and 39, Cowcross St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

FLEXIBLE METALLIC TUBING.
United Flexible Metallic Tubing Co., Ltd., 112, Queen Vict. St., E.C.

HEATING AND COOKING APPARATUS.
Belling & Co., Derby Rd., Edmonton, N.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
The Bastian Elect. Heating Syndicate, Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Record Electrical Co., Ltd., Caxton House, Westminster. S.W.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Phœnix House, King William St., E.C.

LADDERS.
Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

LAMPS (Incandescent)—*contd.*
London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

MOTORS AND DYNAMOS.
British Thomson-Houston Co.. Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons, Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

RUBBER GLOVES.
Ingram (J. G.) & Son, Hackney Wick, N.E.
Moseley (D.) & Sons, Ltd., Ardwick, Manchester.

STEAM ENGINES AND TURBINES.
Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk St., W.C.
Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
United States Metallic Packing Co., Ltd., Bradford.

SWITCHGEAR.
British Thomson-Houston Co., Ltd., Rugby.
Dorman & Smith, Ltd., Ordsal Electrical Works, Salford.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Electric Control, Ltd., 177, Reid St., Bridgeton, Glasgow.
Ellison (George), Warstone Lane, Birmingham.
Ferranti Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Igranic Electric Co., Ltd., 147, Queen Victoria St., E.C.
Record Electrical Co., Ltd., Caxton House, Westminster, S.W.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.

TECHNICAL BOOKS.
Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
Constable (Archibald) & Co., Ltd., 10, Orange St., Haymarket, W.
Crosby Lockwood & Son, 7, Stationers' Hall Court, E.C.
Macmillan & Co., Ltd., St. Martin's Street, W.C.

TELEPHONES.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Graham (Alfred) & Co., St. Andrew's Works, Crofton Park, S.E.
Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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With which is Incorporated

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The Government has decided that strict economy in paper is necessary, and, in consequence, to prevent waste, the majority of newsagents and bookstalls will limit their stocks so far as possible to the actual known requirements of their customers. A mere verbal order will, however, be sufficient to ensure that a copy is sent or reserved weekly.

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SUMMARY

MR. ERNEST T. WILLIAMS has replied to the discussion on his Institution paper on the electricity supply of Great Britain. He emphasises the points that the problem should be seriously attacked without delay; that he did not propose to sacrifice vested interests of any kind; that while deprecating Government operation he submitted that Parliament would never put extensive powers into the hands of any organisation other than a Government department or public body; and that he proposed a Board with controlling powers, and preferably also with limited operating powers (p. 188).

WE give particulars of the proposed Australian Scientific and Industrial Council (p. 188).

WE publish a description of the recently electrified Shildon-Newport section of the North-Eastern Railway. About 50 miles of single track is included in this section, which is used chiefly for heavy mineral traffic. Energy is conveyed to the trains through overhead conductors at 1,500 volts, continuous current. There are two sub-stations, where power is converted from 20,000 and 11,000 volts, three-phase, to continuous current at 1,500 volts, this latter voltage being obtained from two rotary converters in series (p. 189).

IN our Questions and Answers page this week the failure of certain electric lift motors to give dynamic braking is discussed (p. 191).

AMONG the subjects of specifications published at the Patent Office last Thursday were transformers and winding of cables. Patents dealing with engine-starters, electric marine propulsion, and wireless telegraphy have been opposed, and one for engine starters has been granted in spite of opposition. Two metal filament patents expire this week after a full life of fourteen years (p. 192).

WE publish a description of the works of the Benjamin Electric, Ltd., in London, which contain complete plant for the manufacture of electric lanterns, reflectors, lighting accessories, etc. (p. 193).

A COMBINED battery and trolley vehicle for goods service has been put into use by the Bradford Corporation (p. 193).

SOME street lighting fittings and a small lamp, run from a reducing transformer, are described on p. 194.

ADVANCES in tariff have been made by several electricity undertakings (p. 195).

ELECTRICITY works extensions are contemplated at Belfast, and mains extensions at Islington (p. 195).

1st LONDON ENGINEER VOLUNTEERS

ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Platoon Commander J. R. G. Williamson.

Next for Duty.—Platoon Commander A. Gerard.

Monday, May 29th.—Technical for Sections 1 and 2, No. 3 Company, 46 Regency Street, S.W. Squad and Platoon Drill, Sections 3 and 4, No. 3 Company. Signalling Class and Recruits.

Tuesday May 30th.—School of Arms, 6–7. Lecture, Mr. J. Roberts, "Water Supply," 7.15. Recruits, 7.15–8.15, Archbishop's Park.

Wednesday, May 31st.—Platoon Drill, No. 3 Platoon, No. 1 Company.

Thursday, June 1st.—Platoon Drill, No. 7 Platoon, No. 2 Company. Shooting for Sections 1 and 2, No. 3 Company, Miniature Range. Recruits, 5.45–7.45. Instructional Class, 5.45.

Friday, June 2nd.—Technical for Sections 3 and 4, No. 3 Company, 46 Regency Street, S.W. Squad and Platoon Drill, Sections 1 and 2, No. 3 Company.

Saturday, June 3rd.—Company Commander Fleming's Instructional Parade, 2.30.

Sunday, June 4th.—Entrenching at Otford: Parade Victoria (S.E. & C. Railway Booking Office), 8.35 a.m. Uniforms, haversacks, and water bottles. Midday rations to be carried. Railway vouchers will be provided.

Unless otherwise indicated, all drills, &c., will take place at Chester House.

LINKING UP ELECTRIC SUPPLY UNDERTAKINGS

HAVING regard to the difficulties that have been encountered in the past with regard to linking up electric supply undertakings, the following communication, which has been addressed to all electric supply undertakings in the United Kingdom, is of particular interest:—

The Central Coal and Coke Supplies Committee have had under consideration the increasing difficulty in providing for the supply of coal to important consumers, and have advised the Board of Trade that in view of the possibility of a serious shortage in the near future every practicable economy in consumption should be adopted without delay. In this connection the Board desire to call attention to the very considerable saving that can be effected by the adoption of arrangements for interconnection and joint working of electric supply undertakings, including interconnection with stations supplying tramways and railways. The Board are aware of the difficulties involved at the present time, particularly in regard to labour and materials, but they are advised that in many cases the necessary arrangements could be made at once, and they wish, therefore, to urge upon electric supply undertakers the necessity in the national interest of taking immediate steps to avail themselves to the fullest possible extent of the powers which exist for the purpose. Any application which may be made to the Board of Trade for their approval of such arrangements under the powers conferred on them by the Electric Lighting Act, 1909 (Section 4, Subsection 3), and the London Electric Supply Acts, 1908 and 1910, will receive their immediate attention. The Board are prepared to assist as far as possible in cases where difficulty is experienced in securing the agreement of all the parties interested in any proposed scheme or in arranging the terms and conditions under which it shall be carried out.

THE ELECTRICITY SUPPLY OF GREAT BRITAIN

Reply to the Discussion in London

MR. ERNEST T. WILLIAMS has communicated to the Institution of Electrical Engineers his reply to the discussion on his Paper on "The Electricity Supply of Great Britain" (see ELECTRICAL ENGINEERING, April 20th, page 141). In reply to Mr. Merz's question as to why we have not made greater progress towards the ideal in electricity supply, he said that the chief reasons are that we have not, as a profession, trained ourselves to consider the electricity supply problem from the standpoint of the country as a whole, because we have been lacking in a central organisation to co-ordinate effort, and because proposed schemes have failed to embrace various interests. On the question as to whether centralisation of plant was ideal, Mr. Williams said that those who have studied the problem in recent years have come to the conclusion that not only is it an ideal arrangement, but also the only one which can give the highest results. If the profession is still in doubt as to what our aim may be, then undoubtedly the sooner all its agencies get to work to clear up the doubts the better. Mr. Williams wished to make it clear that at this stage his proposals were addressed to electrical engineers, and his intention was not to seek the establishment of an Electricity Board first and then proceed to educate engineers as to its advantages. With regard to Mr. Merz's remarks on the unique position of the geography of Great Britain, he said that this is very greatly in our favour for an inter-connected scheme, for with the densely populated districts which require large power stations, the distance between such stations will be comparatively short, and thus their inter-connection made easier and less costly. The remarkable load factor Mr. Merz had attained on the North-East Coast was due to the inter-connection of the stations, which inter-connection had been made possible at reasonable cost by the comparatively small area covered.

In reply to Mr. Chattock, he did not agree with the nationalisation of our electricity supply as that is generally understood. He thought that impossible of achievement in the early future, and not the best solution even if it were achieved. With regard to Mr. Chattock's proposal that no returns shall be expected during the early years on the money spent in carrying out this scheme, he took it that Mr. Chattock referred to the money spent by the proposed Board and not to that which might be expended by municipalities or companies. This proposal touched the fundamental principles of political economy. The Continental school, which will accept such proposals as being sound for benefiting the trade of the country as a whole and Germany in particular, has followed this line of argument with success. The British policy, however, has been different, and with the exception of subsidies to certain steamship lines, the principle followed generally has been that each development must make its own progress without State support. The chief objection to Mr. Chattock's proposal to replace small generating stations by a bulk supply at once is that it would raise powerful opponents, and thus prevent the fruition of the scheme. It would also make the scheme more difficult to establish from a financial standpoint. Wayleaves were of great importance. To seek Parliamentary authority for wayleaves was too cumbersome and slow an operation, and Parliament would not give the drastic powers of authorising and enforcing the right for wayleaves to any but a quasi-Government body such as the proposed Board.

Mr. Williams wished to correct the impression held by Mr. Highfield and others that because he had brought out the idea of trading for the public good, he proposed to do it at a sacrifice to vested interests, whether of capitalists or of engineers. That was not his intention. The crux of the whole position lay in the fact that by working together we could cheapen the cost of electricity and so create a high demand. Mr. Highfield had raised the very important point of the same Board having controlling as well as operating powers. This had been and was one of the real difficulties to be considered. If we could be assured that the requirements of the country could be met without the Board having operating powers he would readily agree that it should only be a controlling Board. If this question of dual powers became a stumbling-block, he would suggest that rather than have no Board or co-ordinating control at all, it would be better to give way on the operating question and carry through the proposal for an Electricity Board with controlling powers only.

We were all agreed that the electricity supply i[illegible] has suffered from legislation, and one object of this sch[illegible] was to remove some of the difficulties. There was no d[illegible] that an Electricity Board, properly constituted, would be of great advantage. Co-ordination of control would make for progress. The Board would be responsible to Parliament, and if any additional link to Parliament than the Parliamentary member of the Board were desired, there could also be an additional member—say, a Government official representing the various Government departments. Though he indicated the possible addition of a Government official, he did not think this was necessary, and he would prefer to see the Board without. We wanted the powers and authority of a quasi-Government body with great freedom of action within certain defined limits.

Mr. Faraday Proctor's support of the scheme and his energetic demand to "get a move on" had the backing of a large number of electrical engineers. The present was no time for discussing academic trifles while the main chance was slipping away. With regard to Mr. Proctor's reference to our problems as being those also of the chemist and others, he suggested that if we were to make an early advance we should be wise not to widen the scope of our inquiry. Once the Board was established there would be unlimited possibilities open to it, but they were for the future rather than the present.

He was in full agreement with Mr. Wordingham that it is important to avoid Government operation in electricity supply. It was for this reason he proposed a non-Government Board with only a Parliamentary member to link the Board up with Parliament. But while deprecating Government operation, he submitted that Parliament would never put extensive powers into the hands of any other organisation than a Government department or a public body. For this reason, and after much consideration, he proposed the Board with controlling powers and preferably also with limited operating powers.

Mr. Rolls's contribution to the discussion he considered of great value, and he had very great sympathy with and respect for the interests to which Mr. Rolls referred, and liked his candid statement of the facts. In evolving the scheme proposed he had kept in view the interests of all sections of the profession; a clause might be inserted in the proposed Act of Parliament to protect engineers of smaller undertakings.

The President had well summed up the situation by pointing out that the success of this or any other scheme depended on the human factor. If we could only get together and bring commonsense to bear on the problem we should soon make some progress. The President's statement that the Council of the Institution would consider views expressed during the discussion in London and the local centres would be welcomed by all.

AN AUSTRALIAN SCIENTIFIC AND INDUSTRIAL COUNCIL

IT has already been announced that the Australian Commonwealth has in hand a scheme for the creation of a Scientific and Industrial Council, whose function it is to place research work of all descriptions upon a national basis. We are now able to give for the first time a few particulars of this scheme. Briefly outlined, it is proposed to establish a Federal Institute of Science and Industry under the control of the Commonwealth Parliament, with a scientific and industrial council of nine members working in conjunction with an executive directorate of three members. This latter Committee will have the main responsibility of managing the Institute, and the twelve members will receive salaries ranging between £2,000 and £2,500 per annum. They will be more or less in the position of the judges of the Australian High Court, being removable only by a resolution passed by both Houses of Parliament. The Chairman of the Executive Directorate will in all probability be a business man, the other two members being selected mainly on account of their scientific qualifications. It is the intention to organise the existing research laboratories in Australia, and the Federal Government will make liberal grants for researches necessary to carry out specific problems laid down by the Federal Institute, whilst it is not improbable that new research laboratories will be constructed by the aid of Government funds. The present intention is that the field shall be divided into physics, chemistry, and engineering, and probably the physical, chemical, and engineering laboratories will be centralised in order to take advantage of the very fine laboratories which have already been established and equipped at the universities. A scheme of this kind has already been prepared. and will come before Mr. Hughes, the Australian Premier, on his return. At the same time it is not inconceivable that the scheme will be placed upon an Imperial basis, a preliminary to which would be the organisation of some central authority in England. If this were done a distribution of research work would be made in which, for instance, metallurgical problems affecting the Commonwealth, or, indeed, the Empire generally, would be investigated at, say, Sheffield University, whilst textile problems would be allocated to the Leeds University. In this way duplication both of facilities and expenditure would be avoided.

A 1,500-VOLT D.C. ENGLISH RAILWAY ELECTRIFICATION

ALTHOUGH 1,200 to 1,500 volts for continuous-current traction has made such progress in the United States that equipment for this voltage has reached some degree of standardisation, little electrification has yet been done in this country at anything over 600 volts. The Lancashire and Yorkshire Railway Co. were pioneers in the development of higher voltages, their Manchester to Bury electrified section at 1,200 volts D.C. now being in successful operation. This section, which was described in our issue of Jan. 27th, is operated on the third rail principle. Now we have another example of the use of these higher voltages in the Shildon-Newport section of the North-Eastern Railway, which has recently been electrified, power being supplied in this case through overhead conductors at 1,500 volts, continuous current. The North-Eastern Railway Company was one of the first main-line British railway companies to adopt electric traction, having in 1904 successfully applied electrical operation to their Newcastle and Tyneside suburban traffic. This company has once more acted as a pioneer of electric traction in applying it to heavy freight haulage. In 1911 the General Manager, Sir A. Kaye Butterworth, instructed their consulting electrical engineers, Messrs. Merz and McLellan, to report generally on the question of electrification with reference to the special conditions of the North-Eastern system, and following the visit of their chief mechanical engineer, Mr. Vincent Raven, with Mr. Merz, to the United States in 1911, the directors decided to proceed at once with a preliminary scheme. The Shildon-Newport route was selected for trial, this being an important freight line dealing almost exclusively with heavy mineral traffic.

Beyond the usual considerations affecting the decision to apply electric traction to such a line, there was a special factor which differentiated the North-Eastern Railway lines from others in the United Kingdom. As is well known, the production and distribution of electric power has been

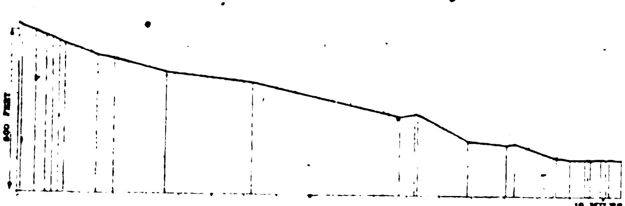


FIG. 1.—PROFILE OF LINE SHOWING GRADIENT.

developed upon a larger scale on the North-East Coast than in any other part of this country, and a large proportion of the power is derived from electric generating stations using as fuel the waste heat and gases derived from coke ovens and blast furnaces in the Durham and the Cleveland districts. An ample supply of cheap electrical energy was therefore available from the systems of the existing power companies, and this fact, obviating as it does the necessity for a large capital expenditure by the railway company on power-station plant, had an important bearing on the scheme.

The electrified line has a route length of between 18 and 19 miles, and connects the mineral sidings at Shildon, which form one of the largest marshalling yards in Great Britain, with the Erimus Sidings at Newport, near Middlesbrough. A considerable portion of the sidings at both ends is also electrified, so that, including the sidings, about 50 miles of single track are equipped for electric working. Fig. 1 is a profile of the line showing the gradient, which is in favour of the laden traffic, the steepest gradient being 1 in 103. The line carries the heavy mineral traffic from the South-West Durham coalfields to the Middlesbrough district, supplying the large number of blast furnaces and iron works concentrated there. On the return journey the load consists mainly of empty wagons returned to Shildon sidings.

Overhead Track Equipment.

The overhead track equipment was carried out under the supervision of the railway company's then chief engineer, Mr. C. A. Harrison. Fig. 2 shows the general type of catenary construction adopted. The overhead contact wires on the main portions of the track consist of two hard-drawn copper conductors, each 0·155 sq. in. section, but on certain portions of the sidings, where the loads are not so heavy, a single contact wire only is used. The wires are supported by a solid steel auxiliary catenary wire, to which they are attached by sliding clips. This auxiliary catenary is in turn suspended from the main stranded steel catenary by means of steel wire droppers. The main steel catenary wire is supported from the steel structures by means of special insulators, double insulation being used throughout. The normal span between the steel structures is 110 yards, but on curves and sidings they are placed at lesser intervals.

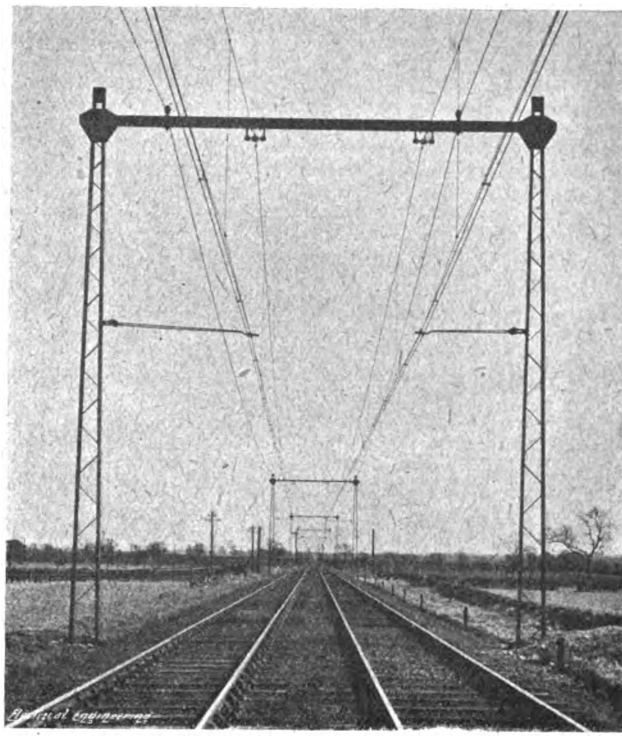


FIG. 2.—MAIN OVERHEAD EQUIPMENT.

The normal height of the contact wire from rail level is 16 ft. 6 in., but at level-crossings this is increased to 18 ft. 6 in., and under some of the low bridges, of which there are a large number on this route, the height from the rail level is reduced, the minimum height being about 13 ft. 8 in.

Two auxiliary stranded copper feeder wires, each of 0·194

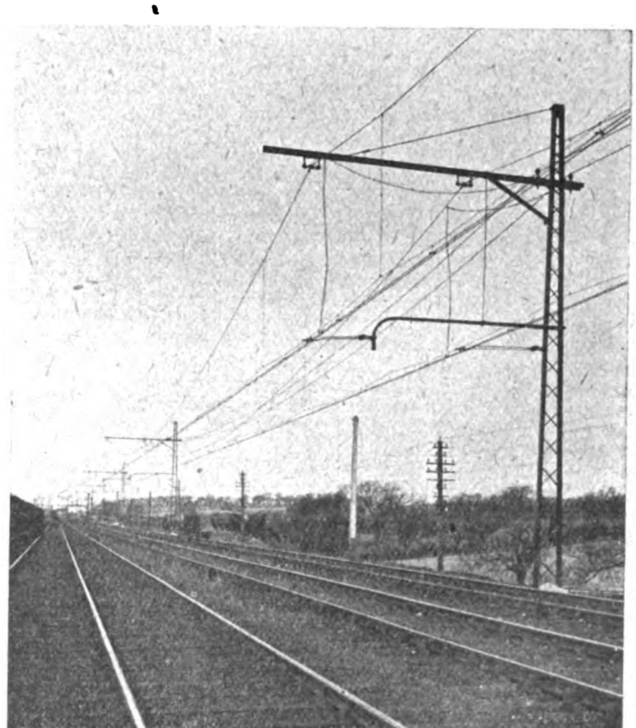


FIG. 3.—CANTILEVER CONSTRUCTION.

sq. in. section, are carried on the top of the steel structures referred to, and are connected in parallel with the main contact wires at frequent intervals. The purpose of these feeder wires is to increase the conductivity of the overhead

equipment. Each steel structure carries a pair of insulated steadying arms, which are pivoted in all directions and are attached to the contact wires by means of clips, their purpose being to fix the position of the contact wire relatively to the track. The contact wires are staggered in the usual way, to prevent undue wearing of the bow collectors. The general type of steel structure carrying the wires over straight parts of the track can be seen in Fig. 2. It consists of two steel masts and a cross-girder, each of these being made up of two channels with flat steel bracing. On curves a centre strut, steadied by steel tie-rods, is added, the steadying arm on the mast on the inside of the curve being removed and fixed to the centre strut mentioned, so as to ensure the steadying arm being always in tension. In Fig. 3 an

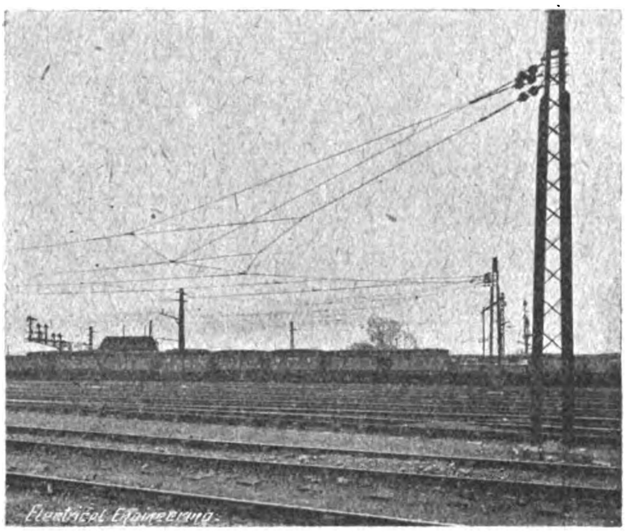


FIG. 4.—TERMINAL ARRANGEMENT.

arrangement is shown of a two-track structure where it was impossible to erect two masts. Cantilever construction is here adopted, the general features of which can be seen from the figure.

All steel structures carrying the overhead track equipment are bonded to the running rails by means of a hard copper bond of 0·08 sq. in. section. Any steel structures carrying signals which are in proximity to the electrical equipment are also similarly bonded to the running rails.

In order to limit as far as possible the sag of the contact wires due to temperature variation, automatic tensioning was adopted. The tensioning points are approximately 1,100 yards apart. There are two tensioning structures placed 50 yards apart at the end of each tension length, the wires from the opposite lengths over-lapping by this amount. The end of each contact wire is raised at the tensioning structure to which it is fixed to a height of about 18 ins. clear of the normal level at that point, so that the locomotive bows ride gently and without shock from one tensioning length on to the next. The contact wires are anchored to the auxiliary catenary wire at a point two-thirds of the distance along each tensioning length in the running direction.

The tensioning structures consist of strong steel masts made up of four angle irons with angle-iron bracing. The tensioning weights are slung in the centre of the mast structure by chains passing over pulleys attached to the contact wire. A normal tension of about one ton is maintained by this means in the double contact wire. The auxiliary catenary wire is in all cases anchored off to the lower girder of the tensioning structure, but the main catenary is continuous except at the tensioning points at which section switches are fitted. At the latter points, the main catenary is also anchored off, but to the top girder.

On some of the sidings where only shunting work is done and the loads on the locomotives are not heavy, a single contact wire is used over each track with ordinary tramway span wire construction. On some of the marshalling and reception sidings, which are not equipped throughout, and on which it is only necessary for the overhead construction to permit of the locomotives entering to pick up their load, the wires are terminated as shown in Fig. No. 4. Danger boards are fitted beyond which electric locomotives should not pass, but if by any chance they should over-run these, the terminal construction is such that no damage would be done to the bow collectors or to the overhead track.

The track is sectioned on the normal length at intervals of about 2½ miles, and considerably more frequently on sidings. Section points are arranged to occur in most cases at tensioning points so as to avoid the use of section insulators. The section switches are fitted in the open so that it is permissible to use the horn break arrangement. They are erected on the uppermost cross girder of the section structures, and operated by levers in the signal cabin to which they are connected by the usual arrangement of railway point rods.

As the train control system of working is in use on this route, the signal cabins are connected by telephone with a central control office situated at Newport, and the handling of these switches is directed from the same point.

The track rails are bonded at the joints with stranded copper bonds fitted under the fish plates, two bonds each of 0·109 square inch section being fixed at each joint. They are also cross-bonded between the two rails at intervals of 300 feet, and between the two inner rails of adjacent tracks at the same space interval, the bonds in the 6 ft. way being midway between those in the 4 ft. way.

Sub-stations.—The power supplied to the overhead line is obtained from two sub-stations, viz., Aycliffe Sub-station and Erimus Sub-station. The voltage of supply to these sub-stations is 20,000 volts, three-phase, for Aycliffe, and 11,000 volts, three-phase, for Erimus, the periodicity being 40 cycles. At the sub-station this power is converted by means of six-phase rotary converters to 1,500 volts D.C., which is the supply voltage to the overhead line.

In each sub-station the E.H.T. switchgear is of the iron-clad compound filled type, the ironclad gear being fitted in a special chamber on the switchboard gallery, with the control panels and instruments mounted immediately in front of same. A special feature of the transmission scheme is the high-voltage D.C. gear. This switchgear has been designed somewhat on the lines of that usually adopted for high-tension A.C. boards, that is to say, the apparatus is of the remote controlled type, and is mounted in cell structure built up of brick walls with moulded stone division slabs, each equipment being thus entirely separated from its neighbour.

Fig. 5 shows one of the rotary converters which were supplied by the British Thomson-Houston Co. The scheme of connecting two rotary converters in series to generate 1,500 volts was adopted as it enabled the machines to be designed with a reasonable commutator speed and a very conservative value of voltage between commutator bars. Three 800-kw. units were installed, two at Aycliffe and one at Erimus, each consisting of two 400-kw., 800 r.p.m., 750-volt, 40-cycle, six-phase, commutating pole rotaries connected in series. The machines were designed and tested to operate normally at 95 per cent. leading power factor, and to withstand an overload of 50 per cent. for two hours, 100 per cent. for ten minutes, and 200 per cent. momentarily. They were subjected to a high potential test of 5,000 volts for five minutes.

On account of the high voltage on the commutator, these machines were specially designed to avoid damage due to flash-over occasioned by short circuits on the system. The operating parts of the brushgear were entirely enclosed, the distance between brush arms was made as great as possible, and the commutator was completely screened by arc-proof insulating material from the armature and frame of the machine. Tests were carried out to determine what load could be suddenly

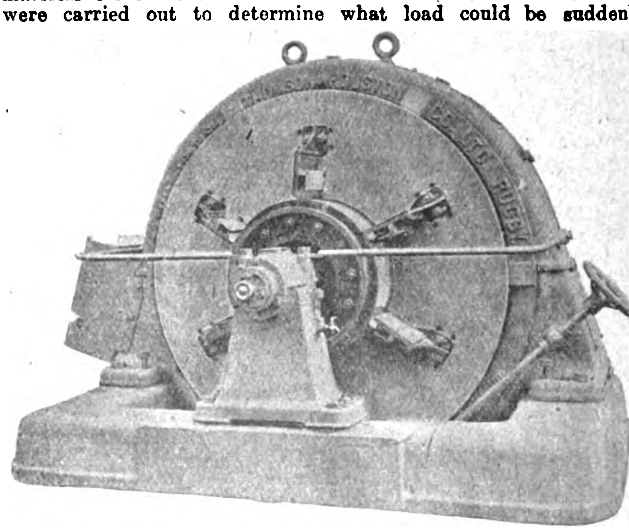


FIG. 5.—SUBSTATION ROTARY CONVERTER.

thrown on and off these sets without flashing. Five times full load was thrown on, and automatically tripped off with a breaker seven times, and three times out of the seven the machines stood this severe test without flashing. The British Thomson-Houston Co. are at present installing at Erimus another set, but of 1,200-kw. capacity, consisting of two 600-kw. rotary converters coupled in series to form one unit.

Each sub-station is connected to the overhead track by four positive feeders, consisting of paper insulated bitumen sheathed single-wire armoured cables, each 0·5 sq. in. section laid in wood troughing run in with bitumen. There are two negative cables at each sub-station, connecting the track rails to the negative busbar, these cables being similar in size and type to those used on the positive side.

(To be concluded.)

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,495.

At an industrial works there is a small A.C. plant, 3-phase, 50 periods, 440 volts. The station capacity is 750 kw., the usual load about 300 to 400 kw., and the capacity of the machines connected to the bars is generally 500 kw., one set being spare. It is desired to take a standby supply from a large supply system at 40 periods through tranformers, to bring the voltage to a low value, say 3,300 or less. Further, the plant which is to be installed will be extended in course of time to take care of additional load and also because the small plant may be scrapped ultimately. There are three types of motor generators to be considered, as follows :—

	Motor.	Generator.
(a)	Asynchronous.	Asynchronous.
(b)	Asynchronous.	Synchronous.
(c)	Synchronous.	Synchronous.

What considerations lead to the adoption of one of these types, especially as regards efficiency, simplicity of working, parallel running, and first cost? The cost should take account of the control gear required.—A. R. T. C.

(Replies must be received not later than first post, Thursday, June 1st.)

ANSWERS TO No. 1,493.

I have charge of several electric passenger lifts on D.C. 400 volts with direct-coupled motors running at about 750 r.p.m. On three of the lifts there are so-called dynamic brakes, the armatures being shorted through a portion of the starting resistance when the current is switched off, the shunt currents being also broken through kicking coils; in two cases the shunts are broken on one pole only, in the other case on both. One motor is compound, the series being cut out after starting, the other two are plain shunt. The controllers are by different makers, but act in practically the same way, the shorting switches being on the tails of the up and down switches, which are solenoid controlled. The motors start up on the first step, and everything is in good order. The point is that the dynamic brakes are not a bit of use, and the full duty of stopping comes on the mechanical brakes. What is best to be done? The field coils cannot be left in circuit, as they overheat. Each controller has three solenoids, one for resistances and one each for the up and down switches.—BRAKE.

The first award (10s.) is made to C. E. Shields for the following :—

The motors being crane rated, the field coils cannot be left in circuit on the full pressure, but a permanent resistance can be put in the shunt circuit, which will cut down the current until the windings no longer overheat, this resistance, of course, to be short-circuited when either the "up" or "down" switch is in, or the weak field will make the motor race.

This, however, is not the best method, as a weak field is not what is wanted. To get the best dynamic braking effect, the fields should be excited by the full line voltage, and the resistance through which the armature is short-circuited should be graduated by a rheostat, being gradually cut out as motor slows down. The compound windings we need not trouble about. Dealing first with the field coils, the best thing to do is to fit a relay or solenoid switch in the shunt circuit, the coil being wired up across the armature so that the back e.m.f. puts the switch in, and when motor stops, switch drops out and shunt circuit is broken as before.

The relay should be wound to pull in at about two-thirds of the line voltage. When once in, it will hold up until the motor nearly stops, as the pole piece and plunger will be nearly touching. If, on account of heavy duty, this relay is likely to overheat, it must cut a resistance into its own windings when up. Whether the relay switch is single or double pole depends on existing arrangements.

The second award (5s.) is made to "W. H." for the following reply :—

The reason the dynamic braking is useless is simply because the shunt field circuit is broken, and therefore the terminal voltage of the armature will die away, and consequently no current will flow through the resistance across the armature. Hence there can be no dynamic braking.

The ordinary self-exciting connection cannot be used for dynamic braking, as the armature voltage is absorbed in the resistance across the armature terminals, and with the usual field connections there would be no voltage across the field terminals when generating. It is necessary, therefore, to separately excite the field, and as overheating occurs when the field is left in circuit, the full field current cannot be used; but it should be possible to arrange the field switch so that, instead of actually opening the field circuit, there will be sufficient resistance inserted to reduce the field current, and therefore the heating. A 20 per cent. reduction in field current should be sufficient, and if the dynamic braking is not powerful enough with the weak field, it is a simple matter to cut out a little of the resistance across the armature terminals, thus increasing the braking current, and therefore the braking effort also.—W. H.

Women Electricians.—The question of employing women electricians, raised a short time ago by the Liverpool Electrical Contractors' Association, having fallen to the ground, as we pointed out at the time, the Association has addressed a communication to the Minister of Munitions on the matter. It appears that the Trade Union refuses to allow women to become members, and consequently this hinders their employment where union men are engaged. The Masters' Association has suggested to the Minister of Munitions that a Government measure is necessary to get over the difficulty, but the Minister of Munitions has replied that this is a matter outside his scope.

Chief Technical Assistants Association.—Owing to the war it was thought advisable that the annual dinner should not be held, and an informal gathering of the members took place on Thursday evening, the 18th inst., at the Villa Villa Restaurant. The gathering was made the occasion to present Mr. MacAlister, the Hon. Secretary, with a handsome rose-bowl as a token of appreciation of the work which he has put into the launching and organising of the Association. In reply to the presentation the Hon. Secretary stated that as they had now reached practically the maximum of their membership owing to the limited field from which their members could be obtained, it was hoped that the members would continue as during the past year to contribute to the general welfare of the Association by further discussions on technical matters; and although by present arrangements a large number of subjects were down for discussion, these by no means exhausted the field which was open and of which it was hoped all members would avail themselves.

War Tribunals.—The switchboard attendant at the Cromer Electricity Works, aged 19 years, who has already been allowed two months' exemption, has been granted a further three months, it being explained that he is the only person left with knowledge to attend to the mains and outside work generally. The foreman and superintendent of the Malvern Electricity Works, and also the shift engineer, have been granted conditional exemption.

Association of Supervising Electricians.—A meeting will be held at St. Bride's Institute, Bride Lane, Ludgate Circus, on Tuesday, at 7.15 p.m., when Mr. W. A. Tookey will read a Paper on "Internal Combustion-Driven Electrical Sets."

"ELECTRICAL ENGINEERING" PATENT RECORD

Specifications Published May 18th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

8,107/15. **Transformers.** BRITISH ELECTRIC TRANSFORMER Co. and J. W. MCWILLIAM. Oil-cooled transformers constructed to offer a minimum of oil surface to the air. A pipe or trunk, with or without an oil displacer, extends through the cover so that the oil can pass to and fro to allow of a "breathing" action. (Three figures.)

9,635/15. **Winding-up Cables.** H. S. CASSEL. A system of automatically winding in the slack of flexible cables connecting such apparatus as portable electrically-driven agricultural machinery to an overhead line. The cable is wound in and kept taut by a sheave or drum driven by electric motors controlled by a device acted on by variations in the tension and sag of the conductors. (Fourteen figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: ORANGE [Arc lamps] 12,995/15.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: CAIRNS and STEEL [Joint boxes] 17,333/15.

Dynamos, Motors and Transformers: SVENSKA TURBINFABRIKS AKTIEBOLAGET LJUNGSTROM [Rotary field magnets] 6,495/15.

Ignition: COLIN [Sparking plugs] 14,881/15; SOC. ANON. DES ETABLISSEMENTS DE DION BOUTON [Magnetos] 16,614/15.

Incandescent Lamps: HERMGES [Incandescent lamps] 13,555/15.

Telephony and Telegraphy: BETULANDER [Impulse transmitters for automatic telephone systems] 12,671/15.

Traction: SAMAIA [Automatic signalling] 6,362/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Automobile control] 6,469/15; SOC. ANON. DES ETABLISSEMENTS L. BLERIOT [Car lighting, &c.] 8,466/15.

Miscellaneous: INTERNATIONAL ELECTRIC Co., ROOSE and LE NOIR [Electric signalling] 3,520/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Switchgear, &c.: E. STEIGER [Automatic lighting switches] 6,031/16 (*100,365*).

Telephony: NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSHE THERMO-TELEPHOON MAATSCHAPPIJ [Thermic telephones] 13,902/15.

Miscellaneous: ELECTRIC BOAT Co. [Submarines] 2,742/16 (*100,346*); L. DE FOREST [Production of musical notes] 4,959/16 (*100,358*); C. F. KETTERING and W. A. CHRYST [Electrical systems for engines] 5,841/16 (*100,361*).

Opposition to Grant of Patents

Opposition has been entered to the grant of patents on the following applications:—

1,352/15. **Engine Starters.** E. F. TYLER and W. J. E. BEERE. An electrical engine starter for automobiles of the type in which the pinion is caused to slide into mesh by the longitudinal magnetic pull of the field on an initially displaced armature. A contact device actuated by the axial movement of the armature prevents driving current being applied to the armature before the gear is in mesh.

4,172/15. **Marine Propulsion.** WOLSELEY MOTOR Co. and A. A. REMINGTON. Combination of a propeller, internal combustion engine, and electric motor, so that the engine and motor can be used separately or together, and the motor may start up the engine and propeller in either direction on load to facilitate manœuvring.

4,862/15. **Wireless Telegraphy.** H. R. RIVERS MOORE. An improvement on a system of the same patentee in which oscillations are sent by introducing energy into a circuit with capacity and inductance, and in short-circuiting the inductance on itself and the capacity on the primary of a transformer, the energy is accumulated in the condenser.

The grant of a patent has been allowed on the following application in spite of opposition:—

24,293/15. **Engine Starter.** A. H. MIDGLEY and C. A. VANDERVELL. An electrical engine-starter in which the initial rotation of the armature draws the pinion into mesh by means of a screw thread.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

12,159/02. C. D. ABEL (*Siemens & Halske A.-G.*). Lamp filaments of nanadium, tantalum, or niobium made from oxides of the metals with a suitable binder, afterwards carbonised and reduced.

12,163/02. C. D. ABEL (*Siemens & Halske A.-G.*). Filaments, rods, &c., of the above metal prepared from the powdered metals themselves in combination with a binder and reducing agents, and afterwards sintered and drawn or rolled.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors and Transformers: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Split pole converters] 2,244/08.

Instruments and Meters: W. W. LACKIE and D. J. STEELE [Meters] 2,551/07.

Storage Batteries: T. A. EDISON [Nickel or cobalt films for active material of alkaline accumulators].

Switchgear, Fuses and Fittings: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Discriminating circuit breakers] 2,450/04 and [Controllers] 2,629/06; CUTLER, WARDLE & Co. and WARDLE [Lanterns] 2,103/08; H. J. READ [Controllers] 2,387/09.

Traction: A. S. ADLER [Car lighting switches] 2,438/04; SIEMENS BROTHERS & Co., LTD., and L. M. G. FERREIRA [Signalling] 2,748/07. B. D. FOX and RAILLESS ELECTRIC TRACTION Co. [Polarity indicator] 2,933/09.

Miscellaneous: H. LACY [Electromagnets] 2,887/06; W. PATTERSON [Miner's lamp relighter] 2,720/07.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Technical Papers of the Bureau of Standards:—No. 26: Earth Resistance and its Relation to Electrolysis of Underground Structures, by B. McCollum and K. H. Logan, 9d. net, by post 1s. 3d.; No. 52—Electrolysis and its Mitigation, by E. B. Rosa and B. McCollum, 1s. 3d. net, by post 1s.9d.; No. 56—Protection of Life and Property against Lightning, by O. S. Peters, 1s. 6d. net, by post 2s. (Washington, D.C.; the Government Printing Office).

British v. German Machinery in China.—According to the *Board of Trade Journal* H.M. Commercial Attaché at Peking has forwarded an extract from the annual report for 1915 of the Municipal Electricity Department at Shanghai regarding the shortcomings of their German plant, and comparing its cost for repairs and maintenance with the cost of British machinery also used by the Department. During the year, it is stated, the German-built turbo-alternators broke down owing to the employment of unsatisfactory material in their manufacture and to other mechanical defects. The best of machines may give some trouble at times, but trouble such as was experienced with the German-built machines is directly traceable to faulty construction and a wrong selection of metals. Figures are given showing that the annual cost in repairs and maintenance averages £40 for British machines which have been in use eight years, and £300 per year for German machines which have been running only two years. These figures do not take into account the further losses in the shape of lost revenue resulting from the stoppage of the German machines during the time they were under repair. Not only have German turbines proved defective in Shanghai, but several transformers have also shown marked inferiority as compared with British and American machinery in the municipal service.

WORKS OF THE BENJAMIN ELECTRIC, LTD.

THE London works of the Benjamin Electric, Ltd., is probably the largest English works outside Birmingham containing a complete plant for the manufacture of electric lanterns, reflectors, fittings, and general lighting accessories. Through the courtesy of the managing director, Mr. Guy Campbell, we have been afforded an opportunity of inspecting this plant, and found the installation of modern machine tools and appliances greatly interesting. The plant consists of metal stamping presses of various sizes—one press capable of drawing very large blanks for the manufacture of steel reflectors, &c.; metal spinning

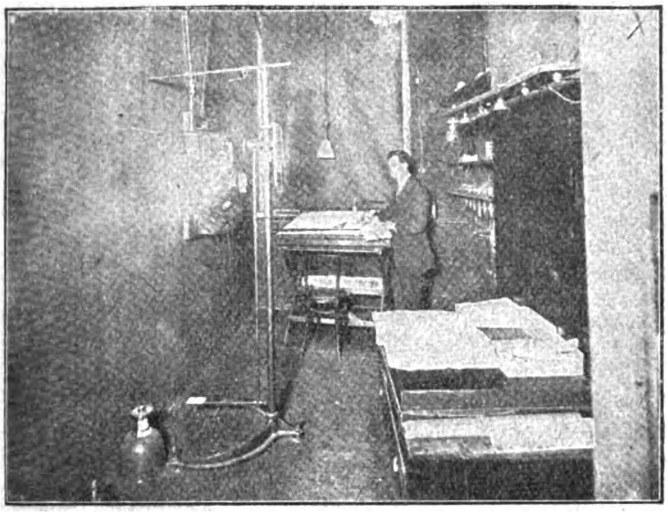


FIG. 1.

lathes, where we saw the most difficult spinning work carried out; a complete enamelling equipment, &c. Other departments are concerned with the production of smaller lighting accessories and with machines for the manufacture of the large Goliath lampholder, which is a particular feature of the firm's products. Science here plays an important part in the design of the productions. All reflectors and fittings are carefully designed in the first instance to give pre-determined results, which fact is largely responsible for the high efficiency. The productions are subjected to photometric tests, some special processes having been the outcome of this research work. At present the laboratory staff is busily engaged in experimenting with cooling devices for use on fittings designed for high candle-power half-watt lamps—a very important problem.

FIG. 2.

Fig. 1 is a photograph of the illuminating engineering department of the works, where reflectors are designed to produce pre-determined results, and the contours of the reflectors are designed by optical calculations and not by the "cut and try" methods generally used. Fig. 2 shows a section of the tool-making and lathe departments in the general machine shop. After the design of any reflector or speciality is completed, the next problem is the manufacture of the tools, and in order to secure the best results the firm have equipped a plant to manufacture all their own tools, which is necessary to get the best manufacturing results in the wide range of designs difficult from a manufacturing standpoint. Fig. 3 shows a double-action stamping press used for drawing the parts of the reflectors.

Since the commencement of the war the works have been fully engaged principally in connection with the large increase in lighting and similar requirements which has been brought about by the war. The electrical accessories trade has suffered severely from German price-cutting and dumping in the past, and if after the war any form of protection is forthcoming there can

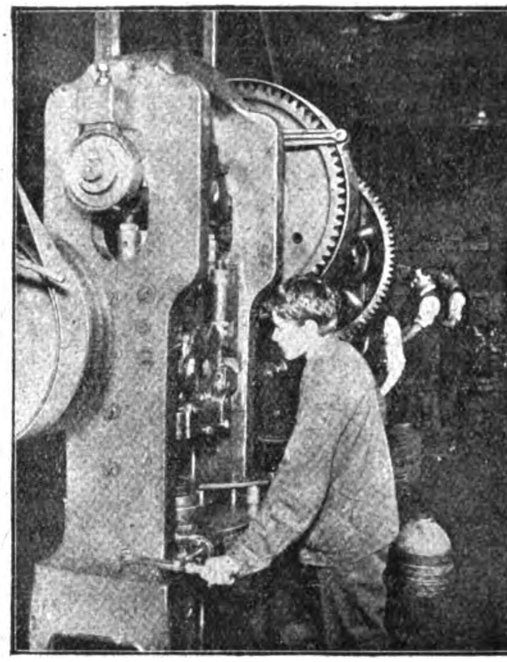


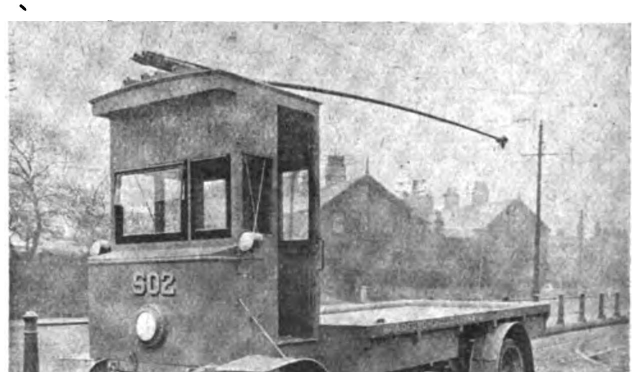
FIG. 3.

be no question that firms such as this will be able to make large manufacturing extensions. As an instance, before the war the majority of Goliath screw lampholders came from Germany, whereas last year this firm produced and sold many thousands all of English manufacture.

A COMBINED TROLLEY AND BATTERY VEHICLE

WE referred briefly recently to a new type of electric vehicle which Mr. C. J. Spencer (General Manager, Bradford City Tramways) has just put to work on his system. This is a lorry built upon the chassis of a trolley omnibus, but provided with a battery enabling it to travel independently of the overhead wires when required. A successful demonstration was made on May 8th before the Chairman of the Bradford Tramways Committee (Mr. E. Priestley), when a two-ton load was carried to Welsey.

The vehicle is shown complete in the illustration. The



equipment of the chassis is identical with that of the ordinary railless trolley chassis as used on the Bradford tramways. Two 20-h.p. motors are used with ordinary series-parallel control, on the 500-volt tramway circuit. The earthing device is an extension of the steering arm of the vehicle bearing on the track by the medium of a cast-iron block, and at the same time automatically steering the vehicle. This device, which has been used with considerable success with the ordinary trackless trolley cars when taking them

over the tramway routes to the depôt, was designed by Mr. E. Cross (General Manager, Rotherham Tramways). The battery employed is of the Edison type, with 120 cells, giving a normal voltage of 150. They supply current to the ordinary 500-volt motors, the only difference being that the motors with battery supply run correspondingly slower, but as the torque of a series motor is proportional to the current passing through the windings, the vehicle is equally capable of climbing steep gradients, although at a speed corresponding to the lower voltage. Whilst the vehicle is running on the 500-volt circuit the batteries may be in series with the motors, thus charging them whilst the car is in trolley service. The battery is capable of running the vehicle about 10 miles.

The change over from battery to overhead wire is merely a question of throwing over a switch, the putting of the trolley on the wire and the earth connector on to the steering gear.

HALF-WATT LAMPS SUPERSEDING ARCS

AN interesting example of the manner in which half-watt lamps can be adapted to arc lampposts of street lighting is shown in the accompanying illustration of the "Boro" type of lantern, containing Osram "Atmos" type lamps of 300 or 500 watts, installed for the Kensington Borough Council on existing arc lamp posts. The outside dimensions of this lantern are equivalent to those of the arc lamps displaced, so that there is no sense of incongruity in the substitution. Moreover, the lantern contains an automatic cut-out and substitutional resistance to enable any number of half-watt lamps to be run in

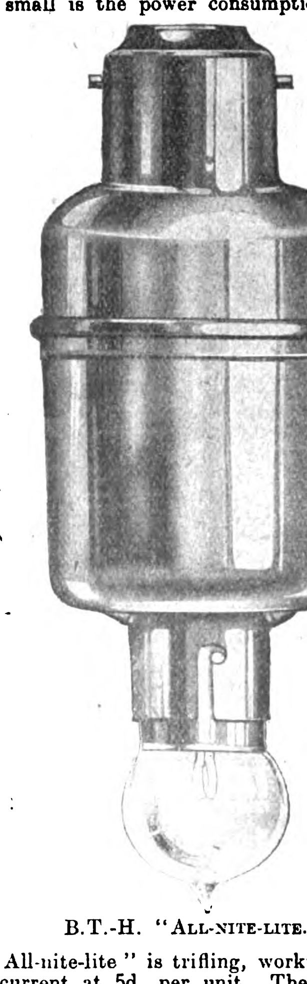
Osram "Boro" Lantern in Kensington High Street.

series. The resistance and cut-out are completely wired and connected up to the two terminals in the top crown. Special care has been taken to provide adequate ventilation. The position of the lamp is accurately fixed in relation to correctly-designed reflectors so as to secure the proper distribution of light at the mounting height. The lantern itself is made of vitreous enamelled steel to withstand all weather conditions, and the globe and reflector, which are fixed together, are hinged and held by fly-nuts, so that they may be readily swung clear for cleaning or for replacing the lamp. The "Boro" lantern is one of the various types manufactured by The General Electric Co., Ltd. (Queen Victoria Street, E.C.), for use with Osram "Atmos" type lamps.

AN ECONOMICAL NIGHT LIGHT

RECOGNISING the demand for lamps of very low power for use in hospitals, nurseries, and sick-rooms at night, and also in passages, cellars, and so forth, the British Thomson-Houston Co., Ltd. (Mazda House, 77 Upper Thames Street, E.C.), have put on the market the "All-nite-lite" transformer, a miniature model that can be inserted in any lampholder. As will be seen from the accompanying illustration, the device has a cylindrical body terminating at its upper end in a standard bayonet lamp adaptor, and at the base in a small bayonet lampholder. Its primary can be wound for any voltage between 100 and 250, the secondary having an output of approximately ½ amp. at 6 volts. A 6-volt 3-c.p. battery lamp with tungsten

filament (taking about 3 watts) is employed, the light given being ample to permit of objects in the room being seen plainly, yet not too bright to disturb the rest of patients or children. So small is the power consumption that the running



B.T.-H. "All-nite-lite."

cost of the "All-nite-lite" is trifling, working out at 1d. for 60 hours, with current at 5d. per unit. The transformer can be inserted in or removed from a holder in a moment, and is, of course, available for use at any point where a lamp exists in a house supplied with alternating current.

LOCAL NOTES

Croydon: *Electricity Charges.*—The Lighting and Electricity Committee recommend that a special war charge of 10 per cent. be added to all electricity supply accounts.

Hamilton: *Electricity Charges.*—Messrs. Edmundsons Electricity Corporation, which runs the electricity works on behalf of the Burgh, having made two advances of 10 per cent. in the charges for electricity, the local authority has complained that the second 10 per cent. is not justifiable and has called upon the company not to impose it until the matter has been further considered.

Harrogate: *Electricity Accounts.*—The accounts for the year to March 31st show a satisfactory state of affairs, an estimated net profit of £122 being, in fact, increased to £1,730. The revenue from sale of current increased by £1,583, notwithstanding the lighting restrictions.

Ripon: *Electric Supply.*—It is proposed to form a syndicate for the purpose of building an electricity works. Mr. Charles Pullan, of Bradford, is organising this matter.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Belfast.—The City Electrical Engineer has submitted a preliminary report of the estimated cost of extending the electricity works on the lines authorised in December.

Dublin.—The Electricity Department requires cast-iron exhaust pipes and supports for a 1,000 kw. Billing's engine. City Electrical Engineer, May 30. (See an advertisement on another page.)

London: *Islington.*—Mains extensions are to be carried out in connection with a scheme which two years ago was estimated to cost £7,500. The actual cost, owing to present prices, will be £10,500.

Miscellaneous

Liverpool.—The Liverpool Overhead Railway Co. requires a twelve months' supply of electrical fittings. General Manager, 31 James Street, May 31st.

London: *Metropolitan Asylums Board.*—A supply of electrical stores is required. Clerk, Victoria Embankment, London, May 30th.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £160 to £156 (last week, £150 to £156).

Liquidations.—The Cedes Electric Traction (Limited), which is being compulsorily wound up, shows a deficiency of £40,833 as regards creditors and £7,001 as regards shareholders. At the first meeting of creditors last week it was pointed out that the company was formed in 1910, and that most of the issued share capital is held by the Austrian Daimler Motor Co. of Vienna. The financial position of the company was being rearranged at the outbreak of war, which, however, put an end to the proposals. The company has been a losing concern ever since its commencement.

Quead Electric Fires.—Messrs. Ikin & Eads, Ltd., 47-57 Marylebone Lane, London, W.C., have, owing to the great demand for Quead fires, decided to form a separate company to control their electric heating department. This will be known as Quead, Ltd., at the above address.

Agency.—A British agent in Saragossa, Spain, who has had ten years' experience of the Spanish market, and who is at present on a visit to London, desires to represent United Kingdom manufacturers of electric fittings. Communications should be addressed to the Secretary, Statistical and Information Department, London Chamber of Commerce, 97 Cannon Street, London, E.C.

APPOINTMENTS AND PERSONAL NOTES

Mr. August Eckstein, of Messrs. Eckstein, Heap & Co., Ltd., Electrical Manufacturers, Caroline Street, Broughton, Manchester, has changed his name to Arthur Erskine.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Electric Construction Co.—A dividend at the rate of 7½ per cent. per annum is recommended on the ordinary shares for the year to March 31st.

West London & Provincial Electric Supply Co.—This company, whose whole income is derived from its investment in the Chiswick Electricity Supply Corporation, which latter has two concerns, one in Chiswick and the other in Aberystwyth, has, like all other electric supply undertakings, felt the effect of the increased price of fuel last year. Coal has gone up from 18s. to 28s. per ton, whilst fuel used for the Diesel engines has increased from 60s. to between 124s. and 140s. In consequence the minimum of 13s. 4d. per quarter per consumer has had to be enforced, and a still further increase is threatened unless fuel costs drop. A 6 per cent. dividend is paid on the cumulative preference shares, although the sum available is smaller by £665 than last year.

Callender's Cable & Construction Co.—There was a nett profit of £242,347 last year, and a 10 per cent. dividend, together with a bonus of 5s. per share, is recommended on the ordinary shares. In addition a special bonus of 5s. per share is to be paid, leaving the sum of £207,347 to be carried forward. The report points out that the ordinary home trade has been much interfered with, but it has been possible to carry out some municipal and other contracts notwithstanding that the shortage of shipping has seriously interfered with the delivery of orders overseas.

Pritchett & Gold and Electrical Power Storage Co.—There was a nett profit of £9,662 in 1915, and a dividend of 15 per cent. is recommended on the "A" ordinary shares, transferring £2,000 to general reserve, £1,000 to reserve for depreciation of investments, carrying forward £2,494.

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(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

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Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Poulton Bros., Ltd , 38 and 39, Cowcross St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

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D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

FLEXIBLE METALLIC TUBING.
United Flexible Metallic Tubing Co., Ltd., 112, Queen Vict. St., E.C.

HEATING AND COOKING APPARATUS.
Belling & Co., Derby Rd., Edmonton, N.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
The Bastian Elect. Heating Syndicate, Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd , 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Record Electrical Co., Ltd., Caxton House, Westminster. S.W.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

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Phœnix Assurance Co., Phœnix House, King William St., E.C.

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Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

LAMPS (Incandescent)—*contd.*
London & Rugby Engineering Co. Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

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Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons. Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

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Ingram (J. G.) & Son, Hackney Wick, N.E.
Moseley (D.) & Sons, Ltd., Ardwick, Manchester.

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Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk St., W.C.
Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
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British Thomson-Houston Co., Ltd., Rugby.
Dorman & Smith, Ltd., Ordsal Electrical Works, Salford.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Electric Control, Ltd., 177, Reid St., Bridgeton, Glasgow.
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Ferranti Ltd., Central House, Kingsway, W.C.
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TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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SUMMARY

IN a Paper read before the West of Scotland Branch of the Association of Mining Electrical Engineers, Mr. J. P. C. Kivlen advocated the adoption of some degree of standardisation in the design and manufacture of switchgear (p. 198).

WE publish an illustrated description of some of the early developments in electric steel furnace practice (p. 198).

PATENT specifications connected with miners' electric lamps and mine signalling have been published during the past month (p. 199).

OUR Questions and Answers page this week deals with the speed control of fans driven by squirrel-cage motors (p. 200).

WE conclude the description of the Shildon—Newport electrification of the North-Eastern Railway. Locomotives are used to haul the trains, which weigh 1,400 tons, a speed of 25 miles per hour being attained on the level. There are four motors per locomotive, each driving an axle through single reduction twin gearing. Each locomotive has two pantographs, containing four bows in all, each bow making double contact, giving eight points of contact per locomotive (p. 201).

AMONG the subjects of specifications published at the Patent Office last Thursday were turbo-alternators, tungsten arc lamps, metal filament lamps, and junction boxes. Patents connected with telephony and wireless telegraphy expire this week, after a full life of 14 years (p. 203).

AN advantage shown by electric clocks when changing over to "summer time," was that large groups of clocks could be advanced simultaneously without the necessity of visiting each separately (p. 203).

THERE was a net profit of £47,497 on the Birmingham Electricity Undertaking last year, and £3,132 at Blackburn.—The Belfast Corporation is to appeal to the Local Government Board with regard to connecting new consumers.—The application of the Charing Cross, City, and West End Electricity Supply Co. for an increase of its maximum charges has been refused (p. 204).

A 3,000-kw. turbo-alternator is required at Stoke-on Trent, and new plant at Rawtenstall. A number of electric supply schemes are under consideration in Australia. An electric capstan is required at Manchester (p. 204).

The difficulties under which the electrical manufacturing industry is suffering were detailed at the annual meeting of Callender's Cable & Construction Co.—A record of dividend of 7½ per cent. is recommended by the Electric Construction Co., and 12½ per cent. by the Lancashire Dynamo & Motor Co. (p. 204).

1st LONDON ENGINEER VOLUNTEERS

ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Platoon Commander A. Gerard.

Saturday, June 3rd.—Parade at Headquarters, 2.45, for Ceremonial Drill. Uniform. Every member is urged to attend.

Monday, June 5th.—Technical for Sections 1 and 2, No. 3 Company, 46 Regency Street, S.W. Squad and Platoon Drill, Sections 3 and 4, No. 3 Company. Signalling Class and Recruits.

Tuesday, June 6th.—School of Arms, 6–7. Lecture, Company Commander Castell, "Bridging," 7.15. Recruits, 7.15–8.15.

Wednesday, June 7th.—Platoon Drill, No. 1 Platoon, No. 1 Company.

Thursday, June 8th.—Platoon Drill, No. 5 Platoon, No. 2 Company. Shooting for Sections 3 and 4, No. 3 Company. Recruits, 5.45–7.45. Instructional Class, 5.45.

Friday, June 9th.—Technical for Sections 3 and 4, No. 3 Company, 46 Regency Street, S.W. Squad and Platoon Drill, Sections 1 and 2, No. 3 Company.

Sunday, June 11th.—Entrenching at Otford. Parade Victoria (S.E. & C. Ry. Booking Office), 8.35 a.m. Uniform, haversacks, and water-bottles. Midday rations to be carried. Railway vouchers will be provided.

Otford Camp.—On and after Saturday, June 3rd, there will be a standing camp at Otford. See monthly orders.

Musketry.—For Nos. 1 and 2 Companies, see Notice and Tables A and B at Headquarters.

Unless otherwise indicated all drills, &c., will take place at Chester House. Nos. 1 and 2 and 3 and 4 Sections, No. 3 Company, will in future be known as Platoons Nos. 9 and 10.

The Economic War.—At a meeting of business men at Liverpool, on Wednesday last week, organised by the British Electrical & Allied Manufacturers' Association and presided over by the Lord Mayor, the following resolution was passed:—

That the indispensable military services rendered by the engineering industry and its fundamental importance in the future as the basis of defensive power and of prosperous development, entitle it to special State recognition in any reform of national and Imperial policy, and to the patriotic support of all public and private users of plant and machinery throughout the Empire.

Birmingham Electrical Engineers' Volunteers.—Reference has been made from time to time to the good work which this corps of electrical men over military age has been doing since the war broke out, and among other tasks which it has undertaken has been the supply and maintenance of a body of skilled engineers for experimental and constructional work in connection with coast defence. We read in the *Birmingham Gazette* that more than 50 men, representing 17 branches of the engineering professions, have joined the Navy for this work, and take duty on H.M.S. *Vernon* for periods of two weeks or more, as and when such periods of duty can conveniently be arranged. Their services have been so useful to the Admiralty that a request is being made to the corps to maintain twice the original number of men. In consequence an appeal is made to draughtsmen, fitters, tool makers, turners, mechanics, wiremen and others with engineering knowledge to volunteer for this work. Applicants should possess good health and be between the ages of 18 and 50, and arrangements have been made for the transfer of specially-selected "Derby" men for the scheme. Further particulars may be obtained from the Commandant of the Birmingham Electrical Engineers' Volunteers, 56 Digbeth, or from the Adjutant, Mr. S. T. Pemberton, 8 Church Street.

War Tribunals.—An application on behalf of the head electrical engineer to Messrs. F. C. Brown & Co., electrical engineers and contractors, of Coventry, has been adjourned for a month in order that the case may come before the Minister of Munitions, it being stated that the firm is engaged on a number of contracts closely allied with munitions work.—Eleven employees in the Blackpool Electricity Department have been conditionally exempted.—The Chipping Norton Electric Supply Co. has been given one month in which to make arrangements to replace a shift engineer, aged 21, whom the company said was indispensable to the maintenance of the supply in the borough. The local manager went so far as to say that the works would have to close down if the man was taken for military service.

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

COLLIERY SWITCHGEAR

A DISCUSSION on the subject of the design and manufacture of switchgear for use in and about mines has recently been absorbing the attention of the West of Scotland Branch of the Association of Mining Electrical Engineers. Mr. J. P. C. Kivlen read a Paper before the Association in which he strongly urged the desirability of some degree of standardisation being adopted by manufacturers of switchgear. He first pointed to the progress that had already been made since the days when the public arc lighting of the city of Glasgow was controlled from a teakwood board about 4 ft. square, on which the switches consisted of flexible cord with wooden handles fixed at the end. Since those days developments had occurred along certain lines, similar in principle but differing in detail in a remarkable degree. For a given job, given free choice, one manufacturer would offer panels 8 ft. by 2 ft., another 7 ft. 6 in. by 2 ft. 3 in., another 7 ft. by 3 ft., and so on; further, the 8 ft. panel might consist of two slabs vertical, while the 7 ft. 6 in. offer might consist of three. One maker would suggest edgewise instruments with horizontal scale, another sector instruments, while a third would offer round meters.

It would be a great advantage to have a standard height for switch-pillars for mines, and standard section bus-bars. In the case of the ordinary panel, standard height, size, thickness, width, and number of slabs, number and disposition of the supporting bolt holes, and standard means of inter-connection would be required. And why not standardise switchboard instruments? Make the 6- or 8-in. round-type instruments of the switchboard pattern apply everywhere. The manufacturer could do what he liked with the movement so long as the containing case, fixing holes, and back (or front) connection terminals were standard. Various national regulations and the multifarious rules, and often idiosyncrasies, of corporate bodies, had in the past given the manufacturer a thorny path. But conditions were better now, and switchgear which conformed to the Coal Mines Act might be installed anywhere and conform with all legitimate rules. Indeed, mining apparatus would be a distinct improvement on the heterogeneous mass of appliances now in use, not only in the heavy industries, but also in the case of the textile and other trades.

Mr. Kivlen referred to the type of cheap motor-starter which Americans began to ship to this country about fifteen years ago—namely, that consisting of a front slate carrying the spring return switch, no-volt coil, overload coil, and terminals, which could be protected by a metal cover if necessary, and the resistance box with a more or less open protected metal cover at the back. British manufacturers made exactly the same thing to-day, and when used underground such apparatus always gave trouble, owing to dirt and damp getting at the resistances and behind the slab. In other instances a sort of metal container was provided where a person could easily touch the resistance coil with the finger. Such stuff was absolutely useless underground. There was no reason why this class of starter could not be built into a proper sheet or cast-iron containing case, and yet with provision for proper ventilation of the resistances.

There seemed to be no great necessity for standardising single-, double-, or three-pole switches, as these were generally used in single units in a detached way, but there was great need for standard fuses of the porcelain replaceable and cartridge types, and for standard clips and breaks. Users had all felt this, but the great diversity in patented designs seemed an unsurmountable barrier. The author referred to the straightforward type of fuse only and not to patented types, the former being used to a much greater extent underground than the latter.

Reference was made to the necessity for a standard plug for gate-end boxes, coal-cutters, motors used for coal-face conveyers, motors used for haulages which take the place of conveyers, and motors used on portable sinking pumps which follow the driving of a mine. When it was decided to provide facilities for charging electric vehicles at all public power-houses throughout the country, a standard plug was at once designed by the I.E.E. and adopted by all those interested. Yet colliery people had tolerated different makes of plugs for years. It was not so much the fact that one coal-cutter was of a different make to its neighbour along the wall. It was where the plug required removing from the machine when the cut was finished into a conveyer, or perhaps a face haulage for the removal of the coal to the loading gate. The plug and socket should be designed with a view to being easily fitted to any of the apparatus just mentioned, and should be capable of being detached therefrom when necessary.

EARLY ELECTRIC STEEL MELTING FURNACES

SOME useful notes on the early development of electric steel furnaces are given in a Paper read before the Sheffield Society of Engineers and Metallurgists by Mr. H. Etchells, and published in the Society's *Proceedings*. The Paper first briefly traces the history of the subject up to 1901, when Heroult and Keller, in France, and Kjellin, in Sweden, succeeded in producing steel by two widely differing electrical systems, from which the French furnaces were described as arc furnaces and the Kjellin furnaces as induction furnaces.

Dealing with induction furnaces first, the author turns to a consideration of how the transformation of small currents at high potential to large currents at low potential was effected by means of the design of the furnace itself. The primary high voltage currents are led through spirally wound coils, and, by means of a closed iron circuit, secondary currents are induced in the bath of steel, which is in the form of a complete ring of small cross sectional area. The grove in which the steel lies has to be made as narrow as is practicable, for, if the resistance is low, there is a tendency to develop large currents, which would check the successful operation of the furnace by self-inductance alone. The simple induction furnace is in fact comparable to a short-circuited transformer.

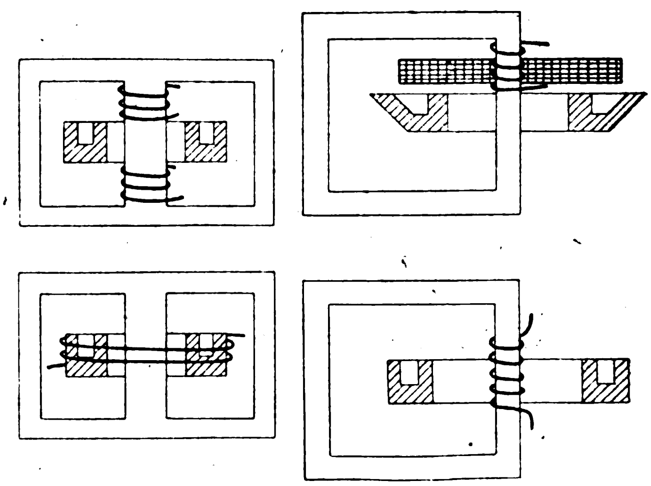

Fig. 1.—Top: Ferranti & Frick Furnaces. Bottom: Colby & Kjellin Furnaces.

Other inventors had the same idea, but different methods of construction. Thus Otto Frick placed the primary windings above and below the plane of the crucible ring, while Mr. Colby, an American engineer, wound one of his furnaces outside and another one inside the circle of the crucible. (See Fig. 1.)

Reports state that, in the Kjellin furnace, the current induced in the steel was about 30,000 amps. at seven volts. It held about 30 cwts., and tapped one ton of steel per heat. The crucible of the Kjellin furnace is generally made of rammed magnesite, aluminised with china clay at the surface. Dolomite has also been used with some success. A good backing of firebrick is put in to retain the heat as much as possible.

The power consumption on the earlier types of furnaces has been stated by Mr. Ibbotson to be 850 units per ton of ingots produced, but this figure has been considerably improved upon since 1906, and it is nearer 650 units a ton now, owing to increased power capacity and improved methods of conserving the heat. The power factor of such furnaces was stated to be from 0·60 to 0·65, which, of course, means con-

siderable expense in capital outlay on generating machinery. It is necessary, in order to get a reasonable power factor at all, to use very low frequency currents from 5 to 15 cycles per sec. There are about ten furnaces of the simple Kjellin type working in various parts of the world, the largest being the one at Poldihutte, of four tons capacity.

The Frick furnaces have been built in larger sizes than the Kjellin. A 6½-ton capacity furnace was built for Krupps and installed at Essen in 1910. The furnace is of 1,000 h.p., and, it is stated, takes about 6½ hours to melt and refine each charge, with an average power consumption of 663 kw. hours per ton. There is not much data available concerning the Frick furnace, but it acts as a refining furnace, as well as a melting furnace. This is different to the operation of the Kjellin furnace, into which pure materials are charged and melted up in a manner comparable to the crucible manufacture of tool steel.

An order was given in January, 1914, by the American Iron & Steel Manufacturing Co., Lebanon, for two 20-ton Frick furnaces, which were to have been supplied by Siemens and Halske, of Berlin. They were to be supplied with 5-cycle single-phase current, at 5,000 volts, and absorb 1,800 kw. each

Since it was obvious that the simple ring type of furnaces, with their narrow channels, did not lend themselves to the method of refining steel by washing it with slags, especially limey slags of high fusion point, a more practical form of furnace was introduced by Rochling and Schonawa, which is generally known as the Rochling Rodenhauser furnace. This consisted in bringing the two circular channels together, so that a wide hearth was formed in the centre of the furnace, where furnace operations could be more conveniently carried out, while the heat was developed in the two narrow channels of liquid steel. Since the slag only derives its heat from the steel under it in these induction furnaces, a secondary coil was

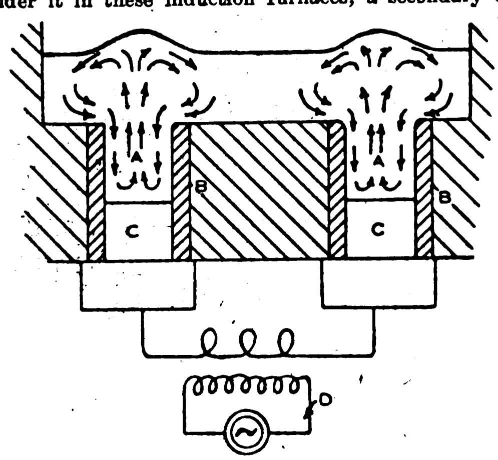

Fig. 2.

wound closely round the primary exciting coils, and the ends connected to buried terminal plates at each end of the wide channel. By this means it is claimed that the slag is superheated. Since three-phase currents were more commonly supplied by the generating stations, and it was thought that electro-magnetic effects, such as self-inductance, magnetic leakage, &c., could be materially improved, a three-phase furnace was constructed, with three channels joined together. By this means an increased power factor from somewhere about 0·80 to over 0·90 was obtained, but the circulation of the metal, which is always taking place in an induction furnace, developed to such an extent in this furnace that it wore the ends of the channels out very quickly. The roof was also rather complicated, and so the furnace was abandoned. The furnaces are now built with a figure 8 crucible, but the armature is split into two cores and one phase of a two-phase supply is wound on each. In 1913 there were 17 of these Rochling furnaces working, distdibuted in such places as Mexico, Spain, and Japan, but out of these are nine in Germany, the largest being a twelve-tonner at Volklingen.

Von Baur states that a 10-ton furnace will melt cold scrap for 590 kw.-hours per ton, and that the two-ton furnace at Volklingen used 700 kw.-hours per ton for melting only, and 200 kw.-hours for refining. These furnaces mainly work on hot charges from Bessemer and Siemens-Martin furnaces. A lime and iron oxide slag is put on first, to wash out the phosphorus, and after it is poured off, a desulphurising and killing process is carried out with lime, fluorspar, and ferro-silicon.

The author then proceeds to describe resistance furnaces, that is, those furnaces in which the charge itself is made to act as a resistance, and is introduced as a part only of the electrical circuit. In distributing the charge so that its electrical resistance shall be high, the same difficulties arise as in the induction furnace. The current leads of the 9 in. furnace are fastened to water-cooled steel electrodes, which are inset at each end of a long, narrow channel containing the steel. The furnace is built on a running bogie, and the same pre-

cautions as to keeping the electrical circuit unbroken in the channel have to be followed as in the Kjellin furnaces. A 700-kw. furnace was stated to have a canal 30 ft. long, 9¾ in. wide, and 19½ in. deep. It would hold about four tons of steel, half filling the groove, and would take 50,000 amps, at 15 volts.

Another system, which has been patented by Mr. Carl Hering, and which it is being sought to apply to steel melting, is shown in Fig. 2. While experimenting with Kjellin furnaces, it was noticed that if the current density in the steel got too great, the steel circuit "pinched up" and broke. It is explained that the steel-filled groove may be likened to a number of parallel conductors, which, when carrying current, strongly repel each other. Hering has applied this idea by bringing the current into the furnace at the bottom of two narrow tubes. The fluid metal "pinches" in the tubes, and, by convection, is rapidly ejected, colder metal flowing in to take its place. It is claimed that the ebullition in the bath is very powerful, though the "pinching" together of the metal in the tubes does not cause such frictional wear on them as might at first appear.

The author goes on to describe very fully the various types of arc furnace in use at the present day, including the Stassano, Heroult, Electrometals, Keller, Girod, Snyder, and Nathusius types. We have previously given some account of these and of present-day electric furnace practice (see Electrical Engineering, March 2nd, p. 72).

ELECTRICAL MINING PATENTS PUBLISHED IN MAY

THE detailed construction of an electric miners' safety lamp adapted to take lamp bulbs of the so-called festoon type of short tubular form with end contacts is described by J. G. Patterson in Specification No. 5,323 of 1915.

Mine signalling is dealt with in Specification No. 8,520 of 1915. The system described permits of various signals being transmitted from a number of different levels and indicated visually in the engine-room. The distinguishing feature of the system is that only one signalling key is provided at each transmitting station, and a delaying arrangement is employed for retarding the visual indication of the signal until after the signal key has been operated the right number of times to produce the required signal.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

Questions : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,496.

When distributor mains are laid for a D.C. three-wire system, three-core cables are used with the neutral conductor generally about half the size of the positive or negative conductor. In the case, however, of three-phase distribution, four-core cables are used, the neutral core being usually made the same cross-section as the phase cores, as at Dublin and other places. If the consumers' loads can be sufficiently balanced on two legs of a three-wire D.C. system so that a neutral conductor of half-section can be used, how is it that with a three-phase system, where the consumers' loads can be connected across three legs, the neutral conductor is not cut down to, say, one-third the size of the phase conductors, as one would expect?—M. J. A.

(*Replies must be received by first post Thursday, June 8th.*)

ANSWERS TO No. 1,494.

It is desired to work a number of centrifugal fans by three-phase 50-cycle induction motors which have squirrel-cage rotors. The speeds of the fans vary from 1,400 to 1,700 r.p.m. It would be an advantage if the motors could be coupled direct and the frequency raised to 60, according to requirements for each motor; failing this, what is the best way to obtain the speed variation economically? The supply is from the corporation at 200 volts.—"Speed."

The first award (10s.) is given to "P. W. C.," for the following reply :—

Assuming that the correspondent requires to run all his existing fans at a speed of 1,700 r.p.m. by means of direct-coupled existing squirrel-cage induction motors, these, however, being designed for 200 volts, 50 cycles, 1,400 r.p.m., 3-phase, then the only method will be to increase frequency to 60 cycles, as suggested. One could hardly expect the corporation to alter the frequency of supply in order to suit individual requirements, and to overcome this difficulty an induction motor alternator set could be installed by the consumer. The motor would be of squirrel-cage type, and wound 8-pole to suit corporation supply, and the alternator 10-pole, which would give a 60-cycle supply, allowing for a 4 per cent. slip on the driving induction motor.

Since the frequency has now been increased to 60 cycles, thus reducing the overload capacity of motors in proportion to $\frac{50}{60}$ approx., it will be necessary to wind the alternator to give a line voltage of, say, 270, 3-phase. This increase of voltage beyond ratio $\frac{60}{50}$ is necessary in order to give motor a safe overload capacity, taking into account that h.p. required to drive fan will increase as $\left(\frac{1,700}{1,400}\right)$, also in order to equalise the increased copper and iron losses.

On figures given above, the output of the motors will now be 1·8×original h.p. at 270 volts, 1,700 r.p.m., 60 cycles, thus increasing the current loading approx. (33 per cent.)^2 and the magnetic loading approx. $(1·125)^2 \times 1·25$, referred to as losses. This additional h.p. is only permissible if the motor, working under original conditions, had a sufficient temperature margin.

If it is found that the current losses could be increased in a greater proportion than above and the iron losses decreased, then the voltage of the alternator could be decreased to suit.

If it is necessary to vary the speed of the fans between 1,700/1,400, this could be done by using a wound rotor motor driving the alternator, and inserting a resistance in the rotor circuit to reduce the speed of set, and therefore frequency of supply.

Assuming that the fans will require to run at any speed between 1,700/1,400, but not necessarily all the fans running at the same speed at the same time, then squirrel-cage induction motors cannot be used. The only system to meet these requirements would be to have a shunt, variable-speed D.C. motor direct-coupled to each fan, supplied by an induction motor direct-current generator set, the motor running from corporation supply mains.

In the first proposition, where the original squirrel-cage motors are retained, it is assumed that the size of existing motors and fans would justify the cost of additional motor generator set, otherwise it would be cheaper to install new fans to give required output when running at 1,400 revs.

The second award (5s.) is made to "Arc," for the following :—

The speed of a squirrel-cage motor can only be varied in one or more of the three following ways :—(*a*) By altering the number of poles. This method is quite unsuitable for the present case, since with a supply frequency of 50 the motors must be wound for 4 poles to give a synchronous speed of 1,500 r.p.m. Two and six poles give speeds of 3,000 and 1,000 r.p.m. respectively. (*b*) By inserting resistance in series with the stator circuit, the effect being to reduce the voltage across the stator windings, and therefore to cause the motor to take a larger current for a given load. The increase in the current results in a correspondingly greater current in the rotor, and consequently the slip is increased. The greater heating and the reduced overload capacity very severely limit the application of this method; and, in any case, a speed higher than the synchronous value is not possible. (*c*) By altering the frequency of the supply to the motor. This can be accomplished either by a motor-generator set or by an induction frequency-changer. The former consists of an alternator coupled to an induction or a synchronous motor, the number of poles on the two machines being arranged so as to give the desired frequency. In the induction frequency-changer, the 50-cycle supply is taken to the stator of a slip-ring induction motor, the rotor of which is connected to the stator of the squirrel-cage fan motor. By driving the rotor of the former machine either with or against the rotating magnetic field due to its stator current, the frequency can be decreased or increased. Thus, in a frequency-changer wound for 4 poles, and supplied at 50 cycles, the speed of the rotating field is 1,500 r.p.m. If the rotor be driven in the same direction at 300 r.p.m., the relative speed of the rotor and the magnetic field is 1,200 r.p.m., and the frequency of the e.m.f.s induced in the rotor windings is consequently $\frac{1,200 \times 2}{60} = 40$. If the direction of the rotor be reversed, the relative speed is 1,800 r.p.m., and the frequency in the rotor is 60 cycles. The advantage of the induction frequency-changer over the motor-alternator is that the combined output of the two machines—the induction motor and the driving machine—comprising the former has only to be equal to the input to the fan motor, whereas in the other each machine has to be capable of dealing with the whole power. For example, suppose that the fan motor requires an input of 30 h.p. at 60 cycles, then with the induction frequency-changer, the main machine acting as a transformer has to cope with 25 h.p., and the driving motor has to give only the remaining 5 h.p.

If each motor must have its speed capable of individual control, a frequency-changer for each machine is necessary, and not only that, but each frequency-changer must be such that the frequency supplied by it can be varied. This can be accomplished either by a belt-drive through stepped pulleys, or by inserting resistance in the rotor circuit of the driving motor.

It will be evident from the above that the desired speed variation of the squirrel-cage motors can only be obtained with a good deal of complication and expense, so that there must be in the present case some exceedingly strong reason against a belt drive with three or four pairs of pulleys (or stepped pulleys for small power) if the direct drive is to be insisted upon.

A 1,500-VOLT D.C. ENGLISH RAILWAY ELECTRIFICATION

(*Concluded from p. 190.*)

Locomotives.—The locomotives are designed to haul trains weighing 1,400 tons at a speed of not less than 25 miles per hour on the level. Fig. No. 6 shows the general appearance of the locomotive. The cab with sloping ends is supported on the centre of each truck by strong steel castings which embody the centre-pin bearing and side rubbing surfaces in one casting securely bolted and riveted to the plates of the cab platform, which consists of four beams secured to plates at the top and bottom. The buffers are carried directly on the truck frames. The trucks are connected by means of a buffer coupling, and arranged for lateral movement with vertical rigidity, the coupling is made with a slotted hole for a drawbar to pass through. The trucks are then securely held together by means of a drawbar and adjustable spring.

The sloping ends are partitioned off from the cab and contain the resistances, contactors, motor cut-out switches, multiple cut-out switches, and all high tension electrical apparatus. Entrance to each sloping end can be obtained through doors which are normally locked.

The bow collectors on the roof of the cab are raised and maintained in connection with the contact wire by compressed air. A cock is fitted on the air system, the removable handle of which forms the key of the doors mentioned. This handle is so arranged that it can only be removed when the cock is in the exhaust position, so that it is impossible to open the doors of the sloping ends while the bows are in contact with the overhead wire. In the cab two master controllers are fitted, one at each end. The cab also contains all auxiliary switches for controlling the air compressor and the two dynamotors described later, and for lighting and heating. It also contains the control valves for the Westinghouse brake and for air sanding. In the centre of the cab there is a vertical hand-wheel for the hand-brake. The dynamotors are securely fixed to the floor, the switches, &c., being fixed on the sides of the cab and weather boards. The total weight of the locomotive is 74 tons, of which 24 tons is due to the electrical equipment.

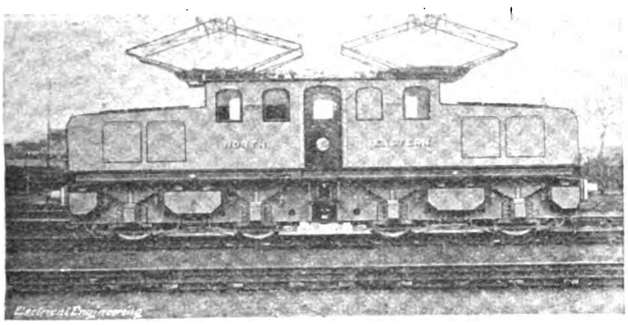

FIG. 6.—N.E RLY. ELECTRIC LOCOMOTIVE.

Motors.—The motor equipment of each locomotive consists of four totally enclosed motors, each driving an axle through single reduction twin gearing. The gears are machine-cut with straight teeth of the involute pattern, the face dimensions of the spur wheels and pinion being 3 15-16 in. A pinion is mounted on each end of the armature shaft, and meshes into a corresponding gear wheel mounted on the running wheel axle, the gear ratio being 1 to 4·5. The motors are suspended by means of a cross-beam suspension bar with bearings and reaction springs. These, with the motor suspension bearings on the axle, provide the motors with four points of suspension.

The four main motors are fitted two on each bogie, and are each wound for 750 volts, the pair of motors in each bogie being connected permanently in series. The four main motors of each locomotive thus form two units, which are controlled on the usual series parallel system. Each motor is capable of developing 275 b.h.p. at a speed of 20 miles for one hour with forced ventilation. The motor equipment is capable without injury of exerting a torque sufficient to skid the wheels under any conditions of rail, and will exert an average pull of 28,000 lb. at the tread of the wheels when starting under normal conditions of rail. The maximum pull at the tread of the wheels is, of course, considerably greater than this. The motors and gearing are designed so as to run at a speed of 45 miles per hour without exceeding the limits of safety, but the normal speed on the level when hauling a train of 1,400 tons is 25 miles per hour. The equipment is so designed that each locomotive is capable of performing four round trips in 12 hours, each consisting of a trip from Shildon to Newport with a train of 1,400 tons, followed by a trip from Newport to Shildon with a train of 800 tons, the distance of each trip being about 18 miles. The locomotives are able to start a train of 800 tons from rest on a grade of 1 in 100, and accelerate to normal running speed.

Tests have been carried out recently with one of the electric locomotives. Several journeys were made between Shildon and Newport, a train of 1,400 tons of laden waggons being taken down from Shildon to Newport, and a train of 800 tons, consisting of 92 empty waggons, hauled from Newport up to Shildon, with stops on certain of the heaviest grades. The 800-ton train was stopped and started on a grade of 1 in 193. The maximum drawbar pull during the tests reached 16 tons, the average speed on the run up from Newport to Shildon being 18·3 miles per hour, the maximum speed being 26 miles per hour. Up a grade of 1 in 230, which is $4\frac{1}{2}$ miles long, the 800 tons load of empty waggons was hauled at an average speed of 23 miles per hour. The locomotive also proved capable of hauling the 1,400 tons train on the level at 26 miles per hour. The general operation of the locomotive proved satisfactory in all respects throughout the test.

A novel feature in the design of the motors is the ring lubrication on the shaft. The gearing is enclosed in a welded sheet iron case fitted with a syphon wick oil lubricator. Sight doors are fitted on the gear case so that the condition of the gears can be regularly examined. The air supply for ventilating the motors is supplied from fans driven by the dynamotors, which are described later. In order to avoid the use of a flexible pipe between the fan air duct in the base of the cab structure and the motors, a special form of spring sliding gland is employed. The fans furnish air to the motors at low pressure, through pipes to a box fitted between the top and bottom plates of the platform, the gland above-mentioned being fitted on this box. The air inlets to the fans are at the ends of the platform, a trough being formed in the cab under structure to convey the air from those inlets. Provision is also made to draw air to the fans from the cab if necessary. The normal quantity of air passed through each motor case is 700 cubic feet per minute.

The main dimensions of the motors are as follows:—diameter of armature, $21\frac{5}{8}$ ins.; length of core, $11\frac{11}{16}$ ins.; length over windings, $24\frac{7}{8}$ ins.; commutator, $18\frac{1}{8}$ ins. diameter by $7\frac{3}{8}$ ins. long, with 195 segments. The speed of the motors at normal locomotive speed of 25 m.p.h. is 787 r.p.m.

Control.—Two master controllers are fitted in the cab one at each end. Notching up can either be carried out by hand or automatically. The automatic arrangement consists of a spring which is wound up by the controller handle, the speed at which the controller drum follows the handle being governed by a step by step escapement movement. The maximum current taken at each step is limited by a limit switch fitted in the sloping ends of the cab, which on the current rising beyond a predetermined limit closes the circuit of a small magnetic interlock, which locks the escapement mentioned, holding the drum of the controller until the current has fallen to the required value. By means of a catch inside the controller, which when lifted disconnects the spring and escapement action, the automatic arrangement described can be thrown out of action, and notching performed by hand.

An acceleration switch is also provided so that in special circumstances the adjustment of the limit switch mentioned can be altered by short-circuiting the turns of an opposing coil, thus allowing of a larger current for accelerating under special conditions. Each master controller is fitted with the usual reversing barrel, the handle of which can only be removed when in the "off" position. When left in this position, the reversing handle locks the main handle. There is also fitted on the master controller a small spring switch by means of which the automatic circuit-breaker on the locomotive can be tripped or set. This switch is also locked by the reversing handle in the "off" position.

Current for operating the whole of the control circuits and the lighting and heating in the cab is supplied from either of the dynamotors at a pressure equal to half the line voltage.

The resistances, which are of the usual cast-iron grid type, are fitted in the sloping ends, but are partitioned off from the other apparatus in these compartments. Openings are fitted at each end of the locomotive providing natural ventilation for the resistances through rainproof air vents on the top of the sloping ends.

The main automatic circuit-breaker is fitted on the roof of the cab, and controls the current to the traction motors. This circuit-breaker is fitted with horned spark gaps which project through the roof of the cab. The circuit-breaker is operated either by means of the set-and-trip switch on the master controllers as mentioned, or by means of a mechanical hand trip fitted on the circuit-breaker case. The circuit-breaker, however, can only be closed by the set-and-trip switch on the master controller. Red and green lamps are provided to indicate whether the circuit-breaker is set or tripped. An illuminated dial ammeter is provided at each end of the cab in front of the driver.

Dynamotors.—As mentioned above, two independent dynamotors are fitted in the cab of each locomotive. The armatures of these machines are double wound and fitted with two commutators, the commutators being connected in series across the full-line voltage. The control circuit is tapped off between the centre point and earth, so that current is obtained for these circuits at approximately half-line voltage. The actual voltage when supplying the control circuits and about one kilowatt for lighting is about 710 volts. The speed is 1,500 revolutions per minute. The shaft of each dynamotor is extended and fitted with a fan, each fan supplying ventilating air to the pair of main motors on one bogie. The rated continuous output with a 50° C. temperature rise is 4·5 kilowatts. Each dynamotor is controlled by an ironclad circuit-breaker and a no-arc fuse. A starting resistance is in circuit with each machine, this resistance being automatically short-circuited by a relay a few seconds after the circuit-breaker is closed.

Air Compressor.—A motor-driven air compressor is fitted in the cab of each locomotive for supplying air for the Westinghouse brake equipment, air sanding, raising the bow collectors, and for air whistles. The machine is capable of dealing with 50 cubic feet of free air per minute, and of raising this to 100 lb. per sq. in. pressure. The machine is run at full line voltage, and is coupled direct in the circuit of the collector bows on the line side of the main circuit-breaker, so that immediately on the bows being raised by the hand-pump the compressor starts up, pumping the air in the reservoir up to full working pressure. It is controlled by an automatic circuit-breaker similar to those controlling the dynamotor circuits, a starting resistance being provided and short-circuited by a relay in the same manner, but in this case the relay is fitted with a time limit arrangement to extend the starting time. An automatic governor is provided for the compressor, and is

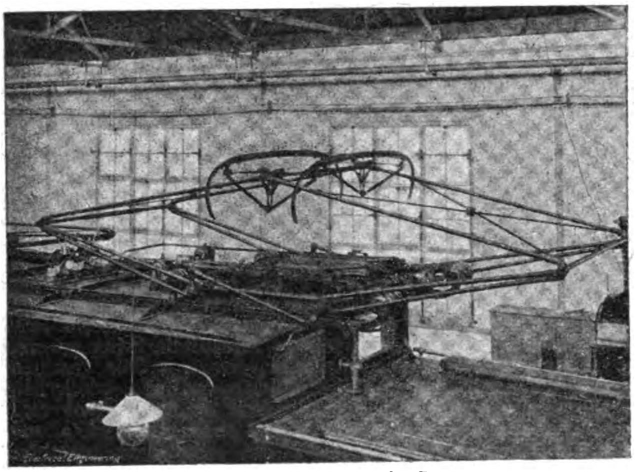

FIG. 7.—PANTOGRAPH & BOWS.

so arranged that the motor circuit is opened when the air pressure rises to 100 lb. per sq. in., and closes again when the pressure falls to 80 lb. per sq. in.

Bow Collectors.—Two bow collectors are provided on each locomotive. These can be seen in position on the roof of the cab in Figs. Nos. 6 and 7. Each collector consists of a hinged pantograph built up of steel tubing, the whole being supported off the cab structure by strong corrugated insulators. Each collector has two bows, each fitted with an aluminium rubbing strip making contact with the overhead contact wire. There are thus four rubbing strips per locomotive, which, with the double contact wire, makes eight points of contact. Each of the two collector bows on a pantograph is attached to it by two separate leaf springs, so that they provide for any small irregularities in the level of the contact wire independently of the vertical movement of the pantograph itself. A hand-pump is provided by means of which the bows are raised at the commencement of the day's working, if no pressure is available in the reservoir. By means of the control cocks in the cab, either one or both of the bows can be raised or lowered. Each pantograph is raised and maintained in contact with the overhead wire by means of an air cylinder, so that in the event of a failure of the air pressure the bows are automatically lowered. The air cylinders raise the pantographs through springs which can be seen in the photographs, and which maintain an even pressure against the contact wire, notwithstanding variations in its height.

The following is a list of the principal firms responsible for carrying out the work:—

Locomotives: North-Eastern Railway Co. *Overhead Track Equipment and Electrical Equipment of Locomotives:* Siemens Brothers Dynamo Works, Ltd., Stafford. *Architect for Sub-station Buildings:* Arthur Pollard, Esq., Architect to the North-Eastern Railway Co., York. *Steelwork and Brickwork for Sub-station Buildings:* R. Blackett & Son, Building Contractors, Darlington. *High-tension Switchgear in Sub-stations:* A. Reyrolle & Co., Ltd., Hebburn-on-Tyne, sub-contractors to the British Thomson-Houston Co., Ltd., Rugby. *Rotary and Static Transformers for the Sub-stations:* The British Westinghouse Electric & Manufacturing Co., Ltd., Manchester, sub-contractors to the British Thomson-Houston Co., Ltd. *Cranes in Sub-stations:* Herbert Morris, Ltd., Loughborough. *Overhead Transmission Lines:* The British Insulated and Helsby Cables, Ltd., Prescot.

AN ELECTRIC RECRUITING VEHICLE

A NOVEL use for the electric vehicle is shown in the accompanying illustration. The car is a standard Edison G.M. 2-ton vehicle in the service of the Liverpool Corporation Electricity Dept., and during the vigorous recruiting rallies in connection with the Derby scheme Mr. H. Dickinson, the City Electrical Engineer, had a special recruiting body fitted as shown, and the vehicle paraded the Liverpool district week by week at the head of a section of the Civilian Training Corps on the occasions of their evening recruiting marches. The battery supplying energy for propelling the van afforded at the same time a ready source of illumination, and a number of electric lamps were fitted inside the body, so that the lettering was well illuminated and produced a very effective appeal; in fact, a considerable number of recruits were obtained as a direct result of the weekly parades.

The vehicle has now been in constant use on its ordinary duties for over a year, and has effected a very considerable

economy in the cartage work of the department. It is employed largely in connection with mains extension work, and, in addition to the actual saving in the cost of carting (which, we understand, amounts on an average to between £7 and £8 per week), a further advantage is afforded by the reduction of time spent by gangs of men in reaching their work, as, apart from carrying the cable and other materials required, the car transports the mains-men, labourers, and tools to the required locality with a minimum of delay.

Mr. Dickinson states that during the 12 months that the vehicle, which was supplied by Messrs. Drake & Gorham, Ltd., 47 Spring Gardens, Manchester, has been in use, it has covered 10,000 miles at an average current consumption of 0·7 units actual input to the battery. Repairs and replacements have been practically nil, so that the total operating costs have been extremely moderate.

Excess Profits Problems.—An article in Friday's issue of the *Financial Times* on the problems of the Excess Profits Duty has drawn attention to the case of electric supply companies, which are in a peculiar position in regard to the Act. Mr. H. B. Renwick, managing director of the County of London Electric Supply Co., quite rightly points out that electric supply companies work under such special restrictions that it would be most inequitable for the present statutory percentage standard to be taken to apply to such undertakings without increasing it by at least 4 per cent. The electric supply companies are under statutory obligations to provide machinery, to lay mains and to give supply wherever required under their Orders, thus necessitating a continuous expenditure of capital in advance of profitable demands, with the result that Ordinary shareholders have to go without dividends for many years in the earlier stages. Further, the companies have a very limited tenure, mostly from 33 to 42 years, during which to earn a return on their capital, and at the end are subject to purchase under conditions which are particularly onerous. They have, therefore, necessarily to look to the latter years of their tenure to compensate for the unproductive early years and to make provision for loss of capital. Certainly these factors should be taken into consideration, and there seems good ground for a modification of the rate by the Board of Referees.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published May 25th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

6,495/15. **Turbo-Alternator.** Svenska Turbinfabriks Aktiebolaget Ljungström. Rotary field magnets with parallel grooves containing the windings and axial bolt connections between the rotor body and the trunnions applied to an axially projecting part of the rotor body. (Four figures.)

12,995/15. **Tungsten Arc Lamps.** J. H. Orange An electric lamp comprising a sealed envelope containing arcing electrodes of tungsten or other suitable refractory material, a filling of suitable gas, and a quantity of vapourisable material, such as mercury, the current conductors being reduced locally in section so as to minimise loss of heat from the electrodes. (Three figures.)

13,555/15. **Metal Filament Lamps.** W. J. Hermges. Lamps with the filaments led up and down as well as horizontally across the bottom of the supporting frame so as to obtain improved distribution of light. (Two figures.)

17,333/15. **Junction Boxes.** W. Cairns and J. Steel. A tubular joint box for wire armoured cables, with removable ends and clamping devices whereby the armouring wires can be fixed to the inside of the end of the box. (Four figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Beaver and Claremont [Cable protection] 6,674/15; Tanner and Claremont [Cable joints] 6,980/15.

Dynamos, Motors and Transformers: Soc. Marius Latour et Cie [High-frequency alternators] 17,872/14; B.T.-H. Co. and Pollock [Dynamos] 10,762/15.

Incandescent Lamps: Canton [Incandescent lamps] 3,760/15.

Instruments and Meters: Philip and Steele [Measuring instruments] 6,930/15.

Switchgear, Fuses and Fittings: Webb [Switches] 7,308/15; Allmänna Svenska Elektriska Aktiebolaget [Time lag switches] 17,535/15.

Telephony and Telegraphy: Mauclaire and Bréon [Arc oscillation generator] 6,296/15; Tigerstedt [Sound directing apparatus for telephones] 6,647/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Wireless systems] 7,367/15; Western Electric Co. (*W.E. Co., U.S.A.*) [Telephone switchboards] 17,876/15; W. J. Mellersh Jackson (*A. Arbib*) [Radiotelegraphic apparatus] 339/16 (*100,384*).

Traction: King [Train lighting] 6,818/15; Grob [Train lighting] 7,177/15; Daimler Motor Co., Lanchester, and Milligan [Electric transmission for automobiles] 7,366/15.

Miscellaneous: Rushton and Coventry Electric Clock Co. [Electromagnetic driving mechanism] 2,404/15; Cantrall [Time alarm and call signals] 7,025/15; Westinghouse Brake Co. [Electrically-driven pump control] 11,627/15; F. Krupp A.G. [Magnetic separators] 488/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos, &c.: Allmänna Svenska Elektriska Aktiebolaget [D.C. generators] 5,391/16 (*100,394*).

Incandescent Lamps: Deutsche Gasglühlicht A.G. (*Auerges.*) [Metal filament lamps] 2,704/16 (*100,387*).

Miscellaneous: E. Woltmann [Electric welding] 6,036/16 (*100,401*).

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

12,554/02. **Telephony:** Siemens Brothers & Co., Ltd. (*Siemens & Halske A.G.*) An automatic telephone exchange system in which the subscriber can use one of a number of calling switches, the individual selection being then carried out in the ordinary manner.

12,706/02. **Wireless Telgraphy.** C. D. Ehret. A syntonic system of wireless telegraphy.

The following are the more important Patents that have become void through non-payment of renewal fees.

Incandescent Lamps: A. Just, F. Hanaman, H. Landesberger, and Vereinigte Elektricitäts A.G. [Metal filaments made on carbon basis] 3,225/06.

Telegraphy: P. C. Hewitt [Wireless telegraphy] 2,496/04.

Traction: C. W. Coleman [Automatic signalling] 1,426/09.

Miscellaneous: F. W. Le Tall (*Cooper Hewitt Elect. Co., U.S.A.*) 3,444/03; P. M. Justice (*Otis Elevator Co.*) [Electrical ammunition hoists] 2,985/08.

ELECTRIC CLOCKS AND DAYLIGHT SAVING

Electric clocks showed up to even greater advantage than usual on the inception of the daylight saving *régime*, as it was possible to advance all the clocks in large buildings, institutions, &c., at once without the necessity of visiting each separately. This was especially so in the case of "impulse" system, such as the "Pulsynetic" system of Gent & Co., Ltd. (Leicester), in which the whole of the clocks of a building are controlled from one pendulum. This, with its simple contact and impulse mechanism, is known as an Impulse Transmitter, and its function is to close, momentarily, a circuit containing a number of impulse clocks every half minute. For convenience of control, however, these impulse transmitters are fitted with an advancing cord, which, when held down by the hand, brings the contact into operation every two seconds instead of every half minute, thus advancing the clocks in its circuit at the rate of 15 minutes per minute, or 60 minutes in 4 minutes. In the case of a large building, therefore, the whole of the dials could be put forward one hour in the space of about four minutes, no matter how large their number. It may be remarked that when their advancing cord arrangement was designed ten years ago, there was no idea of its being used in connection with a daylight saving scheme. It lends itself, however, admirably to the purpose.

It is interesting to note that, while the general public are confronted with the question of altering the clock twice per years under the Daylight Saving scheme, on board sea-going liners the putting forward or backward of the clocks is a daily occurrence. It is not necessary, however, to hold down an advancing cord in the case of Pulsynetic marine clocks while they are being put forward. All the officer in charge has to do is to set a small dial, provided for the purpose, to the number of minutes it is desired to advance or retard the clocks, and next press either an "advancing" or a "retarding" lever, and the clocks then become automatically set, without the necessity of "standing by" while this is being accomplished.

This system could be applied to land clocks with equal facility if desired, and the changing from winter to summer time, and *vice versâ*, could even be arranged to take place automatically, and at the correct hour, on May 21st and on October 1st respectively. A well-known clock on the system we are referring to is that at the Royal Liver chief offices at Liverpool. It is known as "Great George," and has four 25-ft. dials. Each pair of hands, together with its gears, weighs no less than 1 ton, but as they run on a combination of roller and ball bearings, are easily moved by the finger of the hand; hence the operation of setting forward the hands was easily performed by one person. It may be mentioned that "Great George," which was made and erected by Gent & Co., Ltd., of Leicester, and was started on Coronation Day, is electrically controlled from Greenwich, and hence always shows Greenwich time, with the result that it has become the standard timekeeper for Liverpool.

Enemy Firms Wound Up.—Recent lists of enemy firms wound up by the Board of Trade under the provisions of the Trading with the Enemy Acts include the Schorch Electrical Co., 35, Basinghall Street, and Isaria, Ltd., dealers in electric meters, 208, Tower Bridge Road, S.E.

LOCAL NOTES

Belfast: *Electrical Contractors and New Consumers.*—With reference to the deputation to the Corporation regarding the connecting up of new consumers (ELECTRICAL ENGINEERING, May 18th, p. 185), it has been decided to apply to the Local Government Board on the subject.

Birmingham: *Electricity Profits.*—There was a net profit of £47,497 on the working of the electricity department last year, of which £25,000 has been transferred to relief of rates and £22,000 carried forward to a special fund. The output was 117 million units, compared with 83 millions in the previous year.

Bo'ness: *Extension Scheme.*—The National Electric Construction Co. have received instructions from the Council to proceed with a modified scheme of extensions at the electricity works.

London: *City of London: Electricity Charges.*—The Board of Trade has refused the application of the Charing Cross, West End & City Electricity Supply Co. for an increase in the maximum charges at present in their City Electric Lighting Order by 10 per cent. during the period of the war.

Stepney: Further Increase in Charges.—Owing to the increase in the price of coal, the Borough Council has decided again to raise the price of electricity by 5 per cent., making a total addition of 20 per cent., due to war conditions.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Rawtenstall.—New generating plant is required.

Stoke-on-Trent.—In connection with the proposed extensions, the following provisional estimate has been prepared for generating plant:—3,000-kw. turbo-alternator, £14,000; boilers and pumps, £9,500; water-cooler, £2,500; switchgear, £1,000. The total of £33,000 includes a number of incidentals and the Electricity Committee has recommended that the scheme be put in hand.

Miscellaneous

Glasgow.—The Clyde Navigation Trustees require six months' supply of electrical stores. General Manager, 16 Robertson Street. June 5th.

Manchester.—An electric capstan is required at the Stuart Street power-house. Chief Electrical Engineer, Dickinson Street. June 7th.

APPOINTMENTS AND PERSONAL NOTES

Mr. A. H. Seabrook, General Manager of the Marylebone Electricity Department, who in July last undertook certain duties in connection with the Metropolitan Munitions Committee, has nearly completed that work. The Marylebone Electricity Committee recommend that Mr. Seabrook be granted leave of absence "to take up a commission in a special branch of the Army, where his general mechanical engineering experience and the special experience he has gained on munitions work during the last ten months will be utilised."

The Ilkley Corporation requires an electrical engineer to take charge of their supply undertaking, to enable the present manager to join the Forces.

Dundalk Electricity Department require an assistant electrical engineer. Salary, £100 per annum. Applications by June 13th to the Borough Electrical Engineer.

A sub-station attendant, also men to train as assistants, are wanted. (See an advertisement on another page.)

The Bexley Electricity Department want a jointer. (See an advertisement on another page.)

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £140 to £144 (last week, £150 to £156).

CALLENDER'S CABLE AND CONSTRUCTION CO.

THE twentieth ordinary general meeting was held on Thursday, Sir J. Fortescue Flannery, Bart., M.P., presiding.

The Secretary read the notice convening the meeting.

The Chairman, in moving the adoption of the report given on page 195 of our last issue, said the board were very glad indeed to be able to meet the shareholders with a report and balance-sheet comparatively so favourable in the face of national and other difficulties during the past year. They had had great pressure put upon them by the Government in various departments; they had lost a large number of their workmen who had volunteered for the front, and they had had most serious difficulties arising from the restriction of British tonnage. That restriction had caused delay in delivery of raw materials, and enormously increased the cost of the raw materials and of coal. They had also had to contend with the cancellation of orders, or, he might rather say, with the postponement of orders, because they hoped to resume them after the war. The inroads upon their earnings, first by the Minister of Munitions, and secondly by the Chancellor of the Exchequer, especially in the new legislation which was now before Parliament, were also among the difficulties which they had had to encounter. They claimed to have overcome all those difficulties without resorting to any means of which the shareholders would disapprove. They had made no undue profit out of the nation's need, and he desired to emphasise that fact because so many allegations were made at the present time as to what was known as profiteering—that was, traders making profits by excessive charges.

The interruption of their ordinary trade, due to the war, had enabled them to make very considerable changes, some of which would be of advantage after the war, at both their factories. They had placed the whole of their resources not only at the disposal of the British Government, but through them at the disposal, and very largely indeed to the benefit, of their Allies, and the company had set as good an example as they could to their brethren in the electrical trade. Broadly speaking, he was pleased to say that the electrical trade had not been behind any other trade in its patriotic exertions since war broke out. Notwithstanding the difficulties in maintaining their connection for commercial work, both at home and in the Colonies and in neutral countries, they had been able to execute such orders, and had been at great pains to keep alive the world-wide connection which they possessed, because they realised that, whilst doing their duty to the country in a time of war, a duty rested upon them in regard to their shareholders to see that when the war was over they were able to resume their ordinary business with full advantage. The directors believed they had done this, and, indeed, there was reason to believe that their friends were storing up reservoirs of orders for their requirements which would be opened to their advantage very fully when the war was over. One of the most serious matters affecting the country at the present time was the question of transport. The German submarine menace had been on the whole an absolute failure, but they could not deny that it had caused some embarrassment in the meantime. It was, however, the duty of the Government to organise much more thoroughly than they had done the means of relief open to them. These means of relief were the more careful use by the Navy of the mercantile ships that had been requisitioned, and there was no doubt that with the help of a larger amount of selected mercantile advice a very great deal could still be done in utilising the mercantile tonnage which the Navy required to greater advantage, so that some ships might be released for ordinary transport work. A considerable amount of new plant and new buildings had been added to their factories at the request of the Government, and he desired to put on record their appreciation of the very businesslike manner in which the Government had met them and co-operated with them in those expenditures and in getting the buildings and plant ready with speed, so that they might be available for the national resources. In addition to adding new plant they had kept the existing plant up to the fullest state of repair and efficiency. The care of their workers had become more onerous, and they had neglected nothing that would help to maintain the efficiency of their workers and also maintain their health in circumstances of great stress and extra labour.

Mr. T. O. Callender, the managing director, in seconding the resolution, said that 463 men of the permanent staff were on the firm's roll of honour and several hundred of their outside men had also joined up. Eleven had died and four were missing, and he expressed on behalf of the company his sympathy with their relatives. Flight-Lieutenant Reid, whose capture in the recent seaplane raid when endeavouring to rescue a comrade who had fallen into the sea, would be fresh in the public mind, was an employee of the company of whom they were very proud.

His usual full statement of the firm's activities, he said, had to be curtailed, as being a controlled establishment they were doing important work for the Navy and Army which had to be treated as strictly confidential.

The report and accounts were adopted, and the dividends recommended were confirmed.

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SUMMARY

WE are able to give an account of the experiences of the Dublin United Tramways Co. and its staff during the Irish rebellion. Considering the magnitude of the disturbances the company must be congratulated on the comparatively small amount of material damage done to its property (p. 206).

WE give a description of the starting gear for the rotary converters at the sub-stations supplying the newly-electrified Shildon-Newport line (p. 206).

AN important "linking up" scheme is being arranged between the electrical undertakings in Lancashire and Cheshire belonging to both municipalities and companies. It has arisen out of a suggestion by Mr. J. H. Robertson during the recent discussion at the institution on the Electricity Supply of Great Britain (p. 207).

AN article dealing with the large profits which some firms are making, due to war work, argues that some portion, at any rate, of the amount which otherwise, presumably, will be collected under the Excess Profits Tax, should be used to provide means for a "development policy" (p. 207).

WE publish an article dealing with some mechanical considerations in railway motor design, including armature construction, insulation, and brush gear arrangement (p. 208).

OUR Questions and Answers page this week deals with the relative merits of various types of frequency changers (p. 209).

A CORRESPONDENT calls attention to the need for revising the institution wiring rules (p. 210).

AMONG the subjects of specifications published at the Patent Office last Thursday are high-frequency alternators, incandescent lamps, cable joints and commutating poles. A patent for electric propulsion of ships is opposed. Amendments have been allowed in an electric wielding patent. Patents dealing with submarine signalling and wireless telegraphy expire this week after a full life of 14 years (p. 211).

THE linking-up scheme between the Battersea–Fulham–Hammersmith Councils is to be revived in consequence of the Board of Trade's letter on the general question of linking-up (p. 213).

THE Ilkeston Corporation has been recommended to sell its electric supply and tramways undertakings to the Nottinghamshire and Derbyshire Electric Power Company (p. 213).

THE Bradford Corporation is applying for sanction to borrow £100,000 for electrical purposes, and extensions are also contemplated at Sunderland. Electrical fittings are required for the West Ham Workhouse and electric lamps by the L.C.C. Asylums Committee (p. 213).

(*For orders for the week, 1st London Engineer Volunteers, see p.* 211.)

PHENOMENAL PROGRESS AT BARROW-IN-FURNESS

THE annual report for 1915–16 of Mr. H. R. Burnett, the Borough Electrical Engineer at Barrow-in-Furness, indicates that during the past year the undertaking has entered upon a new phase of its history. An increase of 10,208,844 units, or 283 per cent. in the output, is a unique experience for an undertaking with a previous total output of 3,597,410, and very few even of the largest undertakings in the United Kingdom have experienced a similar increase during one year. Although a very large proportion of this additional output is accounted for by the supply to Messrs. Vickers' works, it is satisfactory to note that the output for all purposes, except street lighting, continues to make steady progress; and, in spite of the restrictions imposed by the military authorities, the increase during the past year, irrespec- of Messrs. Vickers' supply, constituted a record for the town. There was a net profit on the undertaking of £12,804 after meeting capital charges for the year 1915–16, compared with £3,162 in the previous twelve months. This in itself is sufficient indication of the expansion of the undertaking. No less than 6½ miles of mains have had to be laid, including the completion of the extra-high-tension ring main, whilst 723 new consumers have been added. The demand for apparatus on hire also continues to increase, there being now 927 pieces of apparatus dealt with in this way. The combined general and traction load factors is 40·36 per cent. against 17·97 per cent. in 1914–15; and we congratulate Mr. Burnett and his staff upon the very considerable extension of the undertaking which is now going on.

No less satisfactory than the large increase in output is the great improvement in the financial position by which this has been accompanied. The revenue has increased from £26,585 to £59,208, and the gross profit from £12,717 to £24,399; and the fact that results such as these could have been achieved at a time when supply authorities throughout the country are almost without exception having to increase their charges in order to meet the greatly increased cost of coal, wages, &c., must be regarded with considerable satisfaction. In consequence of the large increase in output, the total working expenses have necessarily largely increased, but the costs per unit sold under every heading show a satisfactory reduction, the total reduction being 0·325d. per unit to 0·605d., or 34·6 per cent. This reduction would have been even greater but for the adverse conditions as to cost of coal, wages, and materials, the extra cost under the first head being no less than £5,000 during the year. The important bearing that this large increase in output, only rendered possible by the extra-high-tension scheme carried out three years ago, has had upon the total costs of production is shown by the fact that whereas three years ago the capital charges amounted to 0·94d. per unit, last year they were only 0·2d. per unit. Nearly 95 per cent. of the total output has been generated by the two large turbo-alternators, and both these machines have been running practically continuously and frequently overloaded month after month is testimony not only to the reliability of the steam turbine as a prime mover, but also to the care which has been exercised in the running of the plant. As a result of the past two years' working the Barrow undertaking is now in a very strong financial position. Of the total capital expenditure of £171,348, there has been repaid £57,132, or 33·3 per cent. Expenditure of a capital nature from revenue amounts to £6,000, whilst the renewal fund, out of which considerable sums have already been spent, now has a credit balance of £12,282, or 7·2 per cent. of the capital expenditure. The whole of the net profit for 1915–16, after writing off certain capital expenditure for which borrowing powers have not been obtained, has been transferred to the renewals fund.

THE IRISH REBELLION

WE are indebted to the Dublin United Tramways Co. (1896), Ltd., for the following account and photographs of its experiences during the Irish rebellion :—

On Easter Monday, at 12.30 p.m., immediately after the Sinn Feiners occupied the principal public buildings, the tramway company started withdrawing their cars from the city, and at 2.30 p.m. most of them were got safely to their different depôts. In Sackville Street one of the Howth cars was stopped and the motorman and conductor were covered with revolvers and ordered to leave. An attempt was made to upset this car by hand to form a barricade for Earl Street, but this attempt failed, and a charge of dynamite was put underneath it and exploded, but did little or no harm. Eventually this car was burnt, due to the adjoining houses having caught fire and fallen upon it. Another car was caught on the South Quays, and was also burnt in the same way. Minor damage to four or five of the cars was done by rifle-fire. The trolley wires suffered most severely; several miles were brought down all over the city by rifle-fire. Some of the tramway standards were damaged by shell-fire. The photograph of one at the corner of O'Connell Bridge and North Quays shows the remarkable manner in which a shell passed right through the pole. Subsequently this pole, as well as the others damaged, were filled up with concrete reinforced with steel rods on site.

TRAMWAY STANDARD PIERCED BY SHELL.

The day after the outbreak the Sinn Feiners surrounded the power-house, and eventually entered and ordered the men out. All the men coming in carried revolvers, and some of them a revolver in one hand and a dagger in the other. They gave the engineer on watch an hour to clear out, under penalty of death, and ordered that the whole system was to be shut down. This was exactly what the Company had itself decided to do. The Sinn Feiners were apparently satisfied that their wishes were carried out, as they did not return, and the Company remained in occupation of the power-house in its shut-down state throughout the whole of the disturbance, notwithstanding the heavy rifle-fire in the district, which was one of the worst and was the last to give out. No attempt was made to do any damage to the power-station, nor, indeed, was any direct attempt made to damage the cars except from the Sinn Feiners' military point of view. One of the motormen, in getting his car away from the danger zone, was shot and seriously wounded. Another of the men, when coming from a city depôt, was shot dead by rifle-fire from the General Post Office. Several of the tramway employees were shot by stray bullets in the vicinity of their own homes. The loss included the two cars referred to and the damage to the overhead system. The loss of traffic was naturally the most serious that the Tramway Company has ever experienced.

HOWTH CAR DESTROYED BY FIRE AT CORNER OF SACKVILLE STREET AND EARL STREET.

On May 2nd, immediately after the burning of the General Post Office, the fires in the power-station were restarted, and on May 3rd most of the system was in working order. Sniping was very prevalent throughout the whole of the system, which made it uncomfortable for the men repairing the overhead wires, but by May 5th practically every feeder was temporarily repaired and the service restored as far as it would be allowed by the military authorities, who had drawn a cordon around the whole city, and would not allow the cars to pass more than two bridges, one on the south side and one on the north side.

The total damage to the rolling stock, including the two cars destroyed and injuries to six other cars—mainly breaking of glass by rifle-fire—did not much exceed £1,500. The total damage to the overhead system amount to about £500. Considering, however, the amount of property the Company had throughout the city—the various depôts and large number of cars—the Company may be congratulated on their good fortune. The actual stoppage of the system was from 12.30 p.m. on Easter Monday, April 24th, until May 3rd.

Our second illustration shows the Howth car referred to which was burnt. This car, as well as a smaller one destroyed on the South Quays, was eventually towed home on its own wheels. The field coils were destroyed, but the armatures are apparently not very much the worse. Notwithstanding that the metal melted from all the bearings, the trucks are not beyond repair. No damage appears on the truck as the result of the attempt to blow the car up.

SHILDON-NEWPORT ELECTRIFICATION

Rotary Starting Gear

AN interesting feature of the substation installation at Aycliffe and Erimus is the starting gear for the rotary converters. The rotaries themselves we have previously described. The starting gear is of the controller type, the machines being arranged for tap starting. The controllers are mounted at the end of the machine frames and direct on the main floor of the substation, the connections being taken straight down and carried on the basement floor. With regard to the larger sets furnished in Erimus substation, these rotaries are of the self-synchronising type, the starting gear consisting of oil switches mounted in the transformer chamber and operated direct from the switchboard gallery, two oil switches being furnished for each rotary converter, one for the main rotary connections and the other for the starting-motor. The operating mechanism for these oil switches is of the signal lever type, the operating shafts being carried on the underside of the basement floor.

In conjunction with this latter starting-gear an operating handle is provided for controlling the series switch on the D.C. side of the rotary converter; this handle is mounted alongside the operating handles of the starting switches, and a system of interlocks is furnished for these three units, arranged so that (1) before closing the starting-motor switch the other two switches must be "off," (2) before closing the main oil switch the starting switch must have been closed, (3) the closing of the series switch automatically opens the starting switch. In conjunction with this starting gear an instrument panel is fixed alongside the operating handle. This panel contains an A.C. voltmeter to indicate that the rotary is in synchronism before closing the main starting switch. A D.C. voltmeter is also fitted to indicate the voltage of each rotary before closing the series switch.

The low-tension A.C. and D.C. switchgear at both substations, and the rotary converters with their starting gear, were manufactured by The British Thomson-Houston Co., Ltd., of Rugby, who were the main contractors for the substation plant.

Electrically-Operated Lifting Bridge.—The Keadby bridge, which crosses the River Trent about fourteen miles north of Gainsborough, has been built with an electrically-operated lifting span of the Scherzer rolling lift type. This span is said to be the heaviest bridge of its type yet constructed in Europe, having a weight of approximately 3,000 tons. A special engine-room has been constructed for the generation of current, both for working the bridge and for operating the electric signals. Battery-houses are provided on each side of the river, one for working the bridge and the other for the signal circuits.

Chief Technical Assistants' Association.—A meeting of this Association will be held on Saturday, June 10th, at 3 p.m., at the Tavistock Hotel, Covent Garden, when a discussion will be opened by Mr. Young on "The Advantages and Disadvantages of Various Types of Mechanical Stokers."

LINKING UP ELECTRICITY SUPPLY UNDERTAKINGS

An Important Lancashire and Cheshire Scheme

Although the restrictions of the Electric Lighting Clauses Act of 1899 as to "association" between one electric supply authority and another were repealed by the Electric Lighting Act of 1909 in so far as a bulk supply may now be taken or given by consent of the Board of Trade and without the necessity for going to Parliament, it was only after a hard struggle that the industry secured this common-sense amendment of the existing legislation. The main idea, then, was to provide for neighbouring authorities giving each other assistance in the case of breakdown, a proceeding which was illegal prior to 1899. A number of agreements have since been entered into under the terms of the Act of 1899, notably on the part of the municipal electric supply authority in the East and North-East of London, but it cannot be said that the Board of Trade has hitherto shown any great desire to point out other directions in which these powers might be utilised to the common good.

The Circular issued recently by the Board of Trade (Electrical Engineering, May 25th, p. 187), however, on the question, has a greater significance than might at first sight be supposed, and may have a considerable bearing upon the whole problem of electric supply in Great Britain in the future. The circular, at any rate, emphasises and gives added point to a movement which has just been started in Lancashire.

In the discussion at Manchester on Mr. E. T. Williams' recent Paper to the Institution of Electrical Engineers (Electrical Engineering, April 27th, p. 149), Mr. Robertson, Chief Electrical Engineer to the Salford Corporation, in pointing out that a national bulk supply scheme as proposed by Mr. Williams was not feasible at the present time, threw out the suggestion that a scheme for interconnecting the principal supply undertakings in the industrial districts would be of enormous benefit, and referred particularly to the advantages of such a scheme for the Lancashire and Cheshire districts.

The matter was taken up forthwith by the Municipal Electrical Association of Lancashire and Cheshire, and at a meeting held in the Manchester School of Technology under the Chairmanship of Mr. S. L. Pearce, City Electrical Engineer at Manchester, on May 9th, and attended by a large majority of the chief engineers of the electrical supply undertakings (municipal, company, and railway) interested in the matter, a Committee was formed to prepare a tentative scheme for the interconnecting (where possible from an engineering point of view and commercially feasible) of the principal supply stations of the two counties.

The Committee formed was as follows: S. L. Pearce (Manchester, Chairman; B. Welbourn (Prescot Electric Light Co.), Vice-Chairman; J. A. Robertson (Salford), Hon. Secretary; C. C. Aitchison (Rochdale); S. E. Britton (Chester); H. Dickinson (Liverpool); E. H. Edwards (South Lancashire Tramways Co.); R. Blackmore (Stalybridge); J. Purrett (Lancashire Electric Power Co.); S. J. Watson (Bury); P. P. Wheelwright (Blackburn); J. A. F. Aspinall (Lancashire & Yorkshire Railway).

The area of supply coming within the scope of the Committee has been divided into the following districts: Manchester inner district; Manchester outer district; Stalybridge and Oldham district; Liverpool district; North Lancashire district; Cheshire district.

Sub-Committees have been allocated to these various districts to obtain the necessary technical data, and this will be compiled and tabulated at an early date.

The Central Committee will then be in a position to review the whole question and to present their report, including estimates of cost to the various municipal committees and supply companies. Being assured of sympathetic consideration from the Board of Trade, there should be no difficulty in carrying out the scheme without additional Parliamentary powers, and in view of its importance at the present time it is hoped that the Local Government Board will also lend its assistance to enable the financial difficulties to be overcome. We understand that the Committee hopes to have its report ready in four or five weeks.

Enemy Firms Wound Up.—The Board of Trade has made an order under the Trading with the Enemy Amendment Act, 1916, requiring the winding-up of Messrs. Krupka & Jacoby, Ltd., importers of electric lighting fittings, &c., 26 to 36 Chapter Street, Westminster.

The Institution and its Allied Members.—The confirmatory meeting of the members of the Institution of Electrical Engineers to finally dispose of the resolutions dealing with alien enemy members will be held on Thursday, June 15th, at 5.15 p.m.

THE EXCESS PROFITS TAX AND FUTURE DEVELOPMENT POLICY

The following article, received from an occasional contributor to our columns, raises a point of considerable interest upon which there is much diversity of opinion. In publishing it we would warn our readers that although the general principle is sound that firms who now find themselves comparatively affluent should not neglect pioneering and publicity work with a view to placing themselves in a good position for a continuance of their prosperity after the war, yet it is doubtful whether it is admissible to expend over two-thirds of their profit for this purpose as advocated by the author. On the other hand, there are, unfortunately, too many firms making large profits out of war work who have actually reduced their advertising in their own trade papers and other business-getting expenditure, holding that this is no longer necessary. We must not enlarge too much on the short-sighted policy of such firms for fear of being accused of departing from the disinterested attitude proper to a technical newspaper, but *verbum sat sapienti.*

The excess war profits tax, whilst no doubt intended to prevent the earning of tremendous and exorbitant profits out of the national need, will act in a very harsh manner in connection with many electrical engineering firms. Many electrical firms had anything but really prosperous years previous to the war, and whilst the writer would not hold a brief for permitting private fortunes to be made out of national misfortune, yet he maintains that in many cases this intrinsically well-designed tax may operate very harshly.

Practically speaking, all the large firms were very busily occupied for a long time before the war broke out; this fact is not denied, but it is only fair to ask, on the other hand, as to the profits which were being earned during that period, before the firm becomes taxed to a severe extent on the profit it makes to-day, on Government or any other type of work.

Many electrical firms had paid no dividend for a few years; there had been slack times and also exceptionally keen competition, which kept prices down to a very low level; in addition, it has to be admitted that with many firms the lack of dividends and the consequent poor financial state was due to early mismanagement. The managements which followed the original people had, as a rule, the difficult task not only of making ends meet and showing a profit, but of first wiping off the effect of perhaps five or even more bad years.

Now take the case of a firm which in the year previous to the war just managed to turn the corner, to pay off the last of its debit charges, and leave a profit of, say, £2000 to be carried forward. In the first eighteen months of the war it is possible that this meagre result might be turned into, say, £8,000, or even £10,000, for distribution amongst the shareholders, that the whole of this additional amount would be claimed as excess profit by the taxing authorities, and about 50 per cent. of the same sequestered as an excess profits tax. Such a procedure is extremely hard on any such firm which is just turning the corner, because the greater profits are not really due so much to the war as to the fact that the management have been at work for four or five years straightening things out, in order to put the concern on a firm basis. Certainly the war has enabled the conditions of manufacture to be kept so stable and at such a high output that the results have been increased over and above all expectations; nevertheless, the fact remains that the major portion of such profits would be the result of the hard work of the management in the days before the war. Anything which enables a firm which has been hard up to establish itself firmly must, and especially at such a time, be of national benefit, whilst any policy having the effect of keeping such firms still in the "hard-up" financial stage is a serious drawback, especially when we consider the times which will prevail after the war.

The question is, can we in any way get relief for such firms? Personally, the writer thinks that such a procedure is not really practicable by appeal to the authorities. Naturally, the tax-collecting departments want money and want it in quantity; of necessity they must be run on somewhat cast-iron and hard-hearted lines; we must look for no relief from this quarter, therefore. Relief is possible, however, and that by looking to the best source for any relief, viz., ourselves.

Let us assume that a firm has made £10.000 extra profit during the second year of the war, and consider how this may be allocated. In the first place, it may be allocated as profit and be placed for dividend, with the certainty of being taxed to, say, 50 per cent. Therefore, the firm's shareholders obtain only £5,000 between them, whilst the other £5,000 benefits them not at all, except as members of the Empire. That is to say, the firm who do not pay a penny in taxation of this kind will enjoy the benefits of this firm's taxed £5,000.

On the other hand, we may allow, say, £3,000 to stand as

extra profit and utilise the remaining £7,000 to forward our publicity and foreign representative work. Whilst we are busy with war work other people are busy with the markets of neutral countries. Surely it would pay us to devote a large portion of our profits to keeping in close touch with these markets, to maintaining a first-class advertising scheme in those countries, and, above all, to backing our representatives up with ample means and ample time in which to form and cement connections. Such work would really be performed at no cost whatever if only half of the surplus profits were taken for this purpose, for if they are not used in this manner they will be appropriated by the Government. In no case can this money be given to the shareholders, owing to the excess profits tax; therefore, it is lost to the company. Seeing that it must be spent or given up, why not decide to spend it in a manner which will consolidate the firm's prospects for the future? Considered in such a light, the laying out of the money in such a manner would be a most useful form of patriotism, as it would enable the country to cope with the time after the war with far greater success, and thus to maintain employment at a high level.

Needless to say, the money need not be spent in publicity altogether, but might be partly spent in experimenting, though at present it is publicity and good representation in the neutral markets of the world which our firms require.

The ideal form of publicity would take the form partly of individual efforts solely on behalf of the firm and partly in the form of subscription to some scheme of publicity for the whole of the electrical trade of the country. In this connection the writer wonders when we are to have a scheme of publicity similar to that run by the body known as The British Commercial Gas Association. This association spends large sums of money, which are made up of comparatively small subscriptions, in furthering the interests of the whole of the gas-making and gas-plant manufacturing trades. Naturally, if more gas is sold, everybody in the trade from top to bottom must benefit.

For some reason or other this idea does not seem to appeal to the electrical trade. The business man is told, in his business journal, of the efficiency of gas heating for his office. The sausage manufacturer is kept in touch with the latest devices in gas cooking for his trade by means of attractive advertisements in his trade journal—advertisements, by the way, which are written from his point of view, whilst the manufacturer who makes the machines for grinding the sausage meat is shown, by apparently conclusive figures, that gas-engine driving by means of town's gas is the only method worth his consideration. Added to these appeals comes that made to his wife in her monthly magazine in which the advantages of gas fires and their superiority to all other means of warming rooms are laid out clearly and illustrated in a most seductive manner. Can we wonder that the ordinary man thinks that the electrical trade makes no similar appeal, because it is unable to do so? Yet every one of the gas people's claims could be countered and refuted, if only the industry would work together.

Certainly such schemes cannot be carried out for nothing, but the returns the outlay brings in are tremendous. The money could be found for this work as suggested above. If excess profits are made, the Government will commandeer them. Therefore, don't have any excess profit; use the money to further interests of the business, and so be thoroughly ready for after the war.

The Work of the Patent Office.—The Annual Report of the Comptroller-General of Patents for 1915 states that 154 applications were made under the Patents, Designs, and Trade Marks (Temporary Rules) Act, 1914, for the avoidance or suspension of patent rights, licences being granted in the case of 117 applications. Experience of the working of the temporary rules, however, disclosed a slight ambiguity in the wording, and a further rule was added in June, 1915. Upon the outbreak of war, all applications for patents, designs, and trade marks filed by subjects of any State at war with this country were allowed to proceed as usual down to the time of acceptance, but formal acceptance was not issued. The result was an accumulation of unpublished specifications, some of which, it was felt, might be of importance to the trade of the country. Moreover, until such specifications were published, they could not be cited as anticipations of later applications. It was decided, therefore, to accept and publish these specifications, but to postpone until otherwise directed all further proceedings thereon. The number of documents relating to foreign patents deposited during 1915 was only 286, compared with 815 in 1914, and of this number 93 were on behalf of Germans, 51 on behalf of Austrians, 14 were Turkish, and 29 Hungarian. The bulk of the remainder, namely 75, were in respect of Belgians. The total number of applications for patents during 1915 was 18,191, this number being 6,629 less than in 1915 and the lowest number received in any year since 1887. Whilst this decrease is, of course, due to the continuation of the war, it should be remembered that the figures for 1915 relate to a full year of war, as against five months of war in 1914. Contrary to the usual practice, no indication is given in the report as to the general trend of invention during 1915 as between various branches of industry. Our own Patent Record of course gives all the information of this nature relating to the electrical industry.

MECHANICAL DESIGN OF RAILWAY MOTORS

AN interesting article on some mechanical considerations in railway motor design is contributed to the *Electric Railway Journal*, by Mr. R. E. Hellmund. One most important consideration, says the writer, in the mechanical design of a railway motor armature is that the punchings that form the core must not be subject to loosening under vibration, and in an approved construction which has never given any trouble of this kind the punchings were pressed on to a spider and tightened with a powerful hydraulic press, being subsequently held in place by a ring nut which has practically no chance to get loose. The spider is pressed on to the shaft, which thus is made easily removable if broken. Large teeth in the armature core are desirable, because they will not bend over easily in case the armature rubs against the poles, and this condition naturally leads to armatures with rather few large slots and teeth. The latter feature is also desirable because with few coils the chances of breakdown are reduced, and because larger coils are naturally stiffer and less liable to move under service conditions. On the other hand, excessively large coils are not as favourable for commutation, and it is possible for large coils to be so stiff as to make the rewinding of the armature difficult.

With regard to insulation, the introduction of U-shaped pieces of insulation to reinforce the coils where they leave the armature coil has been found of great value in avoiding coil breakdowns. To avoid shrinkage of the insulation and loosening of the coils, it is desirable to have them compressed as much as possible before they are put into the armature. For this reason the practice of pressing the straight part of the armature core is very desirable. Coils wound of cotton-covered wire and with a wire covering of fibrous material should be pressed before the outer layer of insulation is put on, but strap-wound coils with mica wrappings may be pressed after completion.

With regard to banding, it may be said that too wide bands and too many of them involve certain losses from eddy currents. The use of a strip of tin under the band wire with clips to hold the wires together has been found to increase their life considerably. When an armature is banded, a sufficient number of fillers should be put into the slot so that the coil sticks out of the slot just enough so that the pressure from the band forces the coil down until its top is flush with the top of the teeth in the core. It is very desirable to do the binding while the armature is hot, because the insulating material is most pliable in a hot condition. The use of temporary bands on the armature before putting on the final banding is considered good practice.

With very large commutators the bolted construction is still the only safe method of holding the commutator together, because the proper tightening of a large ring nut is rather difficult. The methods of manufacturing the mica V-rings and of aging the commutators under heat have, however, improved so much in recent years that the use of a ring nut in small and medium size commutators has become fully as safe as the bolted construction. Following the practice of undercutting that has become common in the last few years, the difficulties of commutator maintenance have become almost negligible. Small irregularities in the commutator surface should not cause a properly designed brush to jump, and therefore the masses that are moved up and down with the brush must be kept small, many brush-holder designs including a small vibration spring between the harness and the hammer so that the carbon can move without moving the harness.

Usually, it is desirable not to have the brushes too thin, as they are then more subject to breakage. A thickness of ¾ in., or for small motors ½ in., gives best results. Very high graphite and low-resistance carbons are often not best for railway motors. On the other hand, care should be taken to avoid very hard carbons, and especially those with certain abrasive qualities intended for non-undercut commutators. While such brushes may show up very well in comparative tests on carbon wear, they will prove to be expensive on account of excessive commutator wear. Usually it is better to take out the armature and turn and undercut the commutators than to use abrasive brushes.

In field coils flat copper straps with asbestos tape insulation between the straps have given such excellent results that the use of wire or ribbon-wound coils has practically been abandoned except in very small motors, the insulation between various layers of the field coils usually being made of mica discs. To avoid vibration of field coils, a most important consideration, it is absolutely necessary to introduce a heavy spring underneath the coil, this taking up the inevitable shrinkage of the insulation. To bring the cables out of the core, the best practice seems to attach the cables permanently to a strap inside of the coil with a well-soldered joint and to connect the two cables between the field coils by a similar simple and rugged joint of the sleeve type, this being preferable to the frequently-used arrangement of cable terminals into which the cables are fastened by screws.

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,497.

In a power station here we have a d.c. motor-generator running as a balancing set on a three-wire system. The field coils of the two machines, although of fine wire, do not appear to be shunt connected, and there is no separate excitation. What is likely to be the method of field connection, and how is the voltage of the system regulated by these machines? Also, how is the size of a balancing set determined?—R. R.

(Replies must be received not later than first post, Thursday, June 15th.)

ANSWERS TO No. 1,495.

At an industrial works there is a small A.C. plant, 3-phase, 50 periods, 440 volts. The station capacity is 750 kw., the usual load about 300 to 400 kw., and the capacity of the machines connected to the bars is generally 500 kw., one set being spare. It is desired to take a standby supply from a large supply system at 40 periods through transformers, to bring the voltage to a low value, say 3,300 or less. Further, the plant which is to be installed will be extended in course of time to take care of additional load and also because the small plant may be scrapped ultimately. There are three types of motor generators to be considered, as follows :—

	Motor.	Generator.
(a)	Asynchronous.	Asynchronous.
(b)	Asynchronous.	Synchronous.
(c)	Synchronous.	Synchronous.

What considerations lead to the adoption of one of these types, especially as regards efficiency, simplicity of working, parallel running, and first cost? The cost should take account of the control gear required.—A. R. T. C.

The first award (10s.) is made to "Bel" for the following reply :—

Let us first consider the relative advantages and disadvantages of the three systems suggested in the question :—

System (a).—No continuous current required for excitation; cheapest in first cost, especially if of the squirrel-cage type; absence of synchronising gear, and consequent decrease in cost of control apparatus and in the work involved in starting and connecting the machine to the bus-bars. The magnetising current of an asynchronous generator has to be supplied by the synchronous machines running in parallel with it. It is, therefore, impossible to have a converting station containing asynchronous generators only; at least one synchronous machine must be provided. Further, the terminal voltage of an asynchronous generator can only be controlled by altering the excitation of the synchronous machine.

System (b).—Same as (a) so far as the motor is concerned. It may be mentioned, however, that a slip-ring induction motor in systems (a) and (b) renders it easier to control the division of the load; thus if the load on the set is to be decreased, a slight resistance is inserted into the rotor circuit, the effect being the same as throttling in the case of a steam-engine. The synchronous generator gives much better control over the voltage, but it has the disadvantage of requiring a synchronising apparatus, and consequently more care in paralleling. Also direct current has to be supplied either from a small exciter coupled to the set or from a separate dynamo, thus involving greater expense and a slight decrease in efficiency.

System (c).—The power-factor of the supply system can be improved by over-exciting the synchronous motor, and this should enable "A. R. T. C." to obtain more favourable terms from the supply company. A synchronous motor is not self-starting unless it is fitted with damping grids, in which case it has to be started through an auto-transformer, and the field winding is usually opened in several places by a special switch to prevent the high E.M.F. induced rupturing the insulation. Another method of starting is to fit a small induction motor on an extension of the shaft, and synchronising in the usual way. When synchronous frequency-converters have to be operated in parallel, great precaution must be taken to ensure that the generator is properly synchronised with its bus-bars when the motor has been connected on the supply side. Some trouble may also be anticipated with this system if the load is subject to fluctuations. Suppose a sudden load comes on; the steam-engines *tend* to slow down a little, while the synchronous motor-generator maintains the same speed. The result is that almost the whole of the increase in the load is thrown upon the latter, and may overload it to such an extent as to cause it to fall out of step.

There is still another possible system for converting the frequency—namely, the induction frequency-changer. The machine consists of an induction motor, the rotor of which is driven at such a speed that the secondary frequency has the desired value. Thus a stationary induction motor supplied at 40 cycles has the same secondary frequency. But if the rotor be driven at R revolutions per minute in the opposite direction to that of the rotating field, the frequency of the rotor E.M.F. is $40+Rp/60$, where p is the pairs of poles for which the machine has been wound. In the present case $Rp/60=10$, so that if the machine has two poles the speed of the set must be 600; while a 4-pole machine has to run at 300 r.p.m. The most suitable speed depends largely upon the size of the machines to be installed. The motor driving the rotor of the frequency converter may be either of the synchronous or induction type, preferably the latter, unless the tariffs of the supply company take account of the power-factor. The cost of the induction frequency-changer is much less than that of any of the proposed systems, since four-fifths of the output of the set is converted by a transformer action, and only one-fifth has to be generated in the secondary windings, this amount of power having to be supplied by the driving motor. The principal reason why the induction frequency-changer has not come into greater use is that the voltage regulation must be obtained by auxiliary machines or apparatus. There is no trouble in paralleling a converter of this type.

If the last system be indicated by (d), the above comparisons can be summarised thus :—

(1) Cost :—(d), (a), (b), (c).
(2) Ease of paralleling :—(a), (d), (b), (c).
(3) Voltage regulation :—(c), (b), (d), (a).
(4) Parallel working :—(b), (d), (c), (a).
(5) Efficiency :—(d), (a), (b), (c).
(6) Suitability for displacing present plant :—(d), (b), (c), (a).

The second award (5s.) is made to "W. H." for the following :—

Presumably the standby supply will have a capacity of approximately 600 kw. A motor generator of this capacity would then be capable of dealing easily with the whole of the present load, and would allow about 200 kw. for extensions. At the same time the power factor on the present load should be quite satisfactory with any of the proposed systems.

(a) Considering, first of all, a set consisting of an asynchronous motor and asynchronous generator. This would require, say, an 870-h.p. motor, say 3,300 or 2,200 v.-40 cycles-8 pole, giving a full load speed of 585 r.p.m., and would be coupled to a 10-pole generator, which would run at a speed corresponding to 48¾ cycles. This set would only be suitable for parallel running and the factory power station would have to run at about 47 cycles to enable the generator

to pump current on to the line. The generator would not be any use without 50 cycle (or 47 cycle) current to excite the field. This idea is, therefore, probably useless.

(b) Asynchronous motor and synchronous generator.—Sizes and speeds would be as above, and the output would be at 48½ cycles full load. The overall motor generator efficiency would be approximately 85·5 per cent., including exciter loss. Motor would be simple in operation, and if a squirrel-cage machine is allowable taps could be brought out of the transformer winding for starting purposes, thus saving a starting compensator. As regards the generator this would be very similar in operation to the alternators in the station, and the whole equipment, with the switchgear, would be of the type commonly met with. In operation care would be required to give satisfactory parallel running as the speed of the motor may vary with the load somewhat differently from the sets in the factory power-house. The sets should be easy to parallel, and there should be no trouble with hunting or circulating currents if the sets in the power-house are satisfactory in this respect. The first cost would probably be about £200 more expensive than the first set, but the arrangement is, of course, infinitely more practicable.

(c) Synchronous motor and synchronous generator.—Sizes and poles as before, giving, of course, 50 cycles output frequency on all loads. The overall efficiency would be lower than for (b), and would be approximately 82 per cent. The generator would be as for (b), but there would be the added complication of an exciter panel for the motor and paralleling connections, etc. There would also be the starting arrangement, which could be either a separate induction motor or a squirrel cage winding on the synchronous motor itself. In either case there is an added complication, with the greater possibility of breakdown. It would first be necessary to parallel the synchronous motor with the supply system, and then to parallel the generator with the power-house. Skilled attention would be required for the motor end of this set in order to keep a good power factor in the event of load variation, or a variation in frequency or voltage of the main supply. It would in this case be possible to maintain unity power factor at any load on the motor, which is an advantage. This set would cost at least £300 more than (b) and £500 more than (a) if the switchgear be taken into account.

Taking all points into consideration it would appear that a set consisting of an asynchronous motor and synchronous generator would be most satisfactory unless it is absolutely necessary to maintain 50 cycles, when a synchronous motor becomes essential.

Answers to Question 1,494.—Owing to a slight error in the printing of the first of these answers in our last issue, the "horse-power required to drive fan" was given as $\left(\frac{1700}{1400}\right)$ instead of $\left(\frac{1700}{1400}\right)^3$.

THE G.E.C. CADET CORPS

WITH a view to giving the employees of the General Electric Co. who are under 18 years of age some military training, Mr. Hugo Hirst has instituted the G.E.C. Cadet Corps, the full complement of which—viz., 112, in two platoons—is shown in our illustration. It is attached to the Sussex Yeomanry, and has been in existence for two months. The uniform and equipment have been generously supplied by the G.E.C. The Corps is commanded by Captain E. A. Joyce, who has on his staff 1st Lieut. A. V. Cannon and 2nd Lieut. W. T. Arnold. A regular course of shooting is undertaken at the ten targets at the Cripplegate Institute, and squad and company drill is given on Friday evenings at the Institute.

More than ordinary interest attaches to the Corps, because it has been brought into existence by the help of the management of the General Electric Co., which informs us that not only is the training of immense value in developing the physique of the lads, but it contributes considerably towards increased efficiency in business by making them take a greater interest in themselves, by accustoming them to discipline, by improving their manners, and, last but not least, by the establishment among them of *esprit de corps*.

CORRESPONDENCE

I.E.E. WIRING RULES.

To the Editor, ELECTRICAL ENGINEERING.

SIR,—These days of warfare may not be a suitable time for criticism of the new Wiring Rules issued by the Institution of Electrical Engineers. Electrical contractors and your own reviewer (ELECTRICAL ENGINEERING, March 16th, p. 93) have already noted difficulties and defects in the matter and arrangement of some of the rules. The revised rules must themselves be revised. So much is clear. The object of this letter is to recommend that the wiring committee begin preparations for a revisal as soon as the war work permits. I would suggest also that there should be added to the committee the names of some wiring experts well known for their prolonged effort to raise the standard and the status of this branch of electrical work.

The majority of the committee should be men whose work has been mainly wiring. Many engineers eminent in other branches undervalue the importance and complexity of wiring problems and practice.

Yours, &c.,
"ENGINEER."

Glasgow, June 3rd.

Steam Turbines v. Water-power.—The results of a series of efficiency tests on a 30,000-kw. cross-compound steam turbine in a power station of the Interborough Rapid Transit Co., of New York, have been given in a Paper before the American Society of Mechanical Engineers. It was stated that the thermal efficiency of the turbine was now nearly 25 per cent., equal to that of the gas engine, while the latter involved much higher overhead charges and maintenance costs. For the same reason hydroelectric power, which looked like a gold mine fifteen years ago, was to-day not a good investment. Even at Niagara Falls, where the development charge was at a minimum, and where the supply of water was practically unlimited, hydroelectric power could not compete with that obtained from a modern steam-turbine station when the load factor was less than 50 per cent.

War Tribunals.—Conditional exemption has been granted to the chief electrician of the Blackpool & Fleetwood Tramroad Co., as well as to two engine-drivers at the Company's works.—The electrical engineer at a large Blackpool hydro where there are 1,100 lights has been granted conditional exemption.—The Urban Electric Supply Co. applied last week for exemption for two stokers, one a single man under 25. Under the new list of certified occupations mentioned in another column, the exemption of employees at electricity works does not apply to single men under 25, but two months' extension was granted in this case.—Conditional exemption was granted in the case of two employees of Messrs. Hill, Upton & Co., electrical and mechanical engineers of Oxford. It was explained that these men are at present installing electrical machinery for munition factories.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published June 1st, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

17,872/14. **High-frequency Alternator.** Soc. MARIUS LATOUR & CIE. A method of transforming the frequency of high-frequency currents for wireless telegraphy and telephony, in which a plurality of single or polyphase machines are connected in cascade, and realised in the same frame by utilising for each transformation a separate portion of the periphery of the frame. (Eight figures.)

3,760/15. **Incandescent Lamps.** A. A. CANTON. Lamps with the light emitting body in the form of a coating of tungsten on a cylindrical or other non-conducting support. (Four figures.)

6,980/15. **Cable Joints.** A. E. TANNER and E. A CLAREMONT. A method of jointing the stranded conductors of high-tension cables with the object of ensuring a smooth surface to the conductor at the joint to avoid dielectric strains caused by protruding portions of solder, &c. A metal sleeve is placed over the ends of the conductors, and molten solder allowed to flow in and around it. An exterior sleeve is fixed over the solder by screwing on to a threaded collar on the inner sleeve. (Two figures.)

10,762/15. **Dynamos.** B. T.-H. Co. and A. A. POLLOCK. Reduction of the usual length of commutating pole pieces by cutting away a portion between the outer ends in order to reduce the leakage flux between the commutating pole and the adjacent main pole. (Three figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: KAT and CALLENDER'S CABLE AND CONSTRUCTION Co. [Identification of cables] 11,072/15.

Dynamos, Motors, and Transformers: OSIUS [Electric motors] 15,792/15.

Heating and Cooking: BOURNE [Heaters for radiators] 7,304/15; IGRANIC ELECTRIC Co. (*Cutler Hammer Mnf. Co.*) [Heaters] 11,144/15.

Ignition: MILTON [Ignition apparatus] 7,374/15.

Instruments and Meters: LINCOLN [Thermal measuring instruments] 15,128/15.

Switchgear, Fuses and Fittings: B. T.-H. Co. (*G.E. Co., U.S.A.*) [Control of A.C.] 5,486/15; CADENEL [Switches] 7,151/15.

Telephony and Telegraphy: DICKSON [Telephone transmitters] 13,674/14; TURNER [Telephone systems] 6,480/15; AKTIESELSKABET ELEKTRISK BUREAU [Impulse senders for automatic telephone exchanges] 10,050/15; WESTERN ELECTRIC Co. [Loaded telephone lines] 12,434 and 13,769/15.

Miscellaneous: WAHL [Dry cell] 7,213/15; DE FORTUNY [Dry cells] 9,627/15; BROWN [Vibrators for signalling] 10,059/15; DEUTSCHE SCHWEISSMASCHINEN-BAU-UND-VERTRIEBS-GES. [Welding apparatus] 10,668/15; RYLAND [Magnetic compasses] 11,787/15; SATINOVER [Electrical apparatus for killing insects] 16,044/15.

The following Specification is open to Inspection at the Patent Office before Acceptance, but is not yet published for sale.

Telephony: V. G. WERNER and K. H. WARFVINGE [Communication with moving trains] 6,629/16 (*100,453*).

Opposition to Grant of Patent

Opposition has been entered to a grant on the following application:—

2,841/15. **Electrical Propulsion of Ships.** B.T.-H. Co. (*G.E. Co., U.S.A.*). A system of electric propulsion of ships employing more than one A.C. induction motor of the pole-changing type supplied with current by steam turbine-driven alternators. The control is effected by a single controller, so interlocked that the operations must be carried out in the correct order, which acts upon the motor connections, generator field, and turbine throttle governor.

Amendment allowed

11,079/15. **Electric Welding.** A. P. STROMENGER. This specification describes a system of arc welding in which a metal rod electrode, covered, except at the end, by insulating material, is laid at an angle on the work and pressed thereon. The insulation, however, prevents the end of the rod coming into actual contact with the work. The amendment, which is made at the request of the Quasi-Arc Co., Ltd., limits the claim regarding the insulating material to the use of blue asbestos yarn.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

13,287/02. **Submarine Signalling.** H. H. LAKE (*Submarine Signal Co., U.S.A.*). Microphones for the reception of submarine sound signals.

13,521/02. **Wireless Telegraphy.** SIR O. J. LODGE, A. MUIRHEAD, and E. E. ROBINSON. Receivers or "coherers" consisting in a metallic point dipping into a globule of mercury under an insulating liquid.

The following are the more important Patents that have become void through non-payment of renewal fees.

Incandescent Lamps: A. JUST, F. HANAMANN, H. LANDSBERGER I. SALZMANN, and VEREINIGTE ELEKTRICITÄTS A.G. [Tungsten filaments] 3,684/06.

Electrochemistry and Electrometallurgy: M. RUTHERFORD [Electric furnaces] 4,175/09.

Miscellaneous: A. ROSENBERG [Electromassage vibrator] 4,133/09.

1st LONDON ENGINEER VOLUNTEERS

ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Platoon Commander W. A. J. Watkins.

Next for Duty.—Platoon Commander N. E. Brown.

Monday, June 12th.—Technical for Platoon No. 9, 46 Regency Street, S.W. Squad and Platoon Drill, Platoon No. 10. Signalling Class and Recruits.

Tuesday, June 13th.—School of Arms, 6–7. Recruits, 7.15–8.15.

Wednesday, June 14th.—Platoon Drill, No. 2 Platoon.

Thursday, June 15th.—Platoon Drill, No. 6 Platoon. Shooting for No. 9 Platoon. Miniature Range. Recruits, 5.45–7.45. Instructional Class, 5.45.

Friday, June 16th.—Technical for No. 10 Platoon, 46 Regency Street, S.W. Squad and Platoon Drill, No. 9 Platoon.

Saturday, June 17th.—Probable date of Inspection by Lord French. Special orders will be issued.

Sunday, June 18th.—Entrenching at Otford. Parade Victoria (S.E. & C. Ry. booking office), 8.35 a.m. Uniform, haversacks, water-bottles. Midday rations to be carried. Railway vouchers will be provided.

Otford Camp.—On and after Saturday, June 3rd, there will be a standing camp at Otford. See monthly orders.

Unless otherwise indicated, all drill, &c., will take place at Chester House.

Certified Occupations.—A revised list of occupations which the various Government Departments concerned have, after consultation with the Army Council, certifieed as of national importance has been published. It differs but little in scope from previous lists, but a limit has been placed as regards age upon workers in certain industries who are to be exempted. All classes of workmen in electrical generating stations, including those for tramways and electric railways, are exempted irrespective of age, as are electricians working above ground in the mining and quarrying industries, similar employees in the oil shale mining industry, calibrators employed in electricity meter manufacture, and electrical inspectors employed by Boiler Insurance Companies. Electrical fitters, however, engaged in the manufacture and repair of motors and other electrical plant in factories are not exempted if they are single men under thirty years of age, and a similar age limit has been placed upon departmental managers and foremen engaged in the manufacture of electrical accumulators. Casters, mixers, pasters, lead burners, forming men and battery erectors are not exempt if single and under 25 years of age. The same applies to foremen engaged in the manufacture of mica for electrical or scientific appliances.

NEW SHOP LIGHTING REFLECTOR

WINDOW-DRESSING is an art; not until quite recent times was any serious and well-thought-out attempt made to light by artificial means a shop window in a manner which would display the goods to the fullest advantage. The excellence of the results obtained by concealed electric lamps, fitted with various kinds of reflectors, stimulated both the lighting expert and the window-dresser to further endeavours. It gradually became recognised that a shop window might be even more effective as an advertisement by artificial light than by daylight, owing to the precision and flexibility with which the illumination could be arranged. But the tendency in most cases was

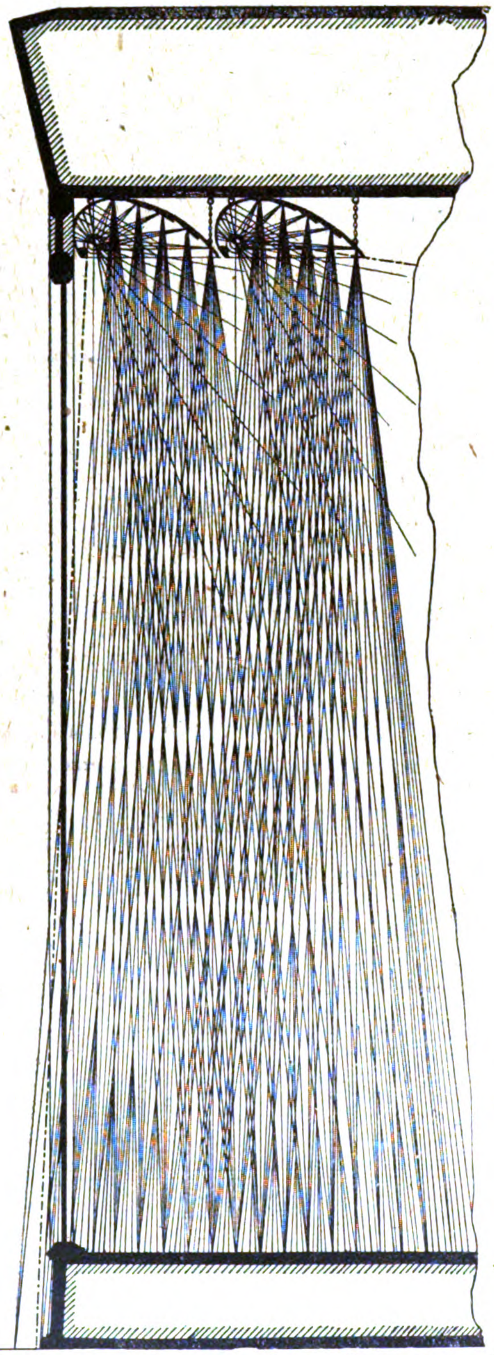

DIAGRAM SHOWING REFLECTED LIGHT RAYS IN THE G.E.C. NEW REFLECTORS FOR SHOP-WINDOW LIGHTING.

for the lighting expert to suggest to the window-dresser the disposition of goods which would give the best effect. A compromise was generally arrived at between the arrangement which the window-dresser would have adopted if daylight alone had been considered and the arrangement which would have simplified the problem for the illuminating engineer.

In a progressive industry such compromises are unstable. The time was sure to come when a shopkeeper would arrange his goods in his own fashion and order the illuminating engineer to light them. From that point to the demand that the permanent illumination should suit any arrangement of the goods equally well was another inevitable step, and it is from this point of view that a method devised for illuminating the typical deep shop window in such a way that every article placed in it, in any position, is lit to the best advantage, is interesting.

Concealed reflectors of the ordinary type throw the rays of light at varying angles on one side of a vertical line. A certain harshness is unavoidable with this arrangement, owing to all the rays falling directly on the front of the articles. Moreover, this system defines a certain line of trim which must be adhered to more or less closely to get satisfactory results.

The diagram shows how these limitations are avoided in a new system of reflectors that has just been brought out by the General Electric Company, Ltd., Queen Victoria Street, London. By arranging plain mirror reflectors of certain dimensions and of certain angles in a conchoidal curve, with lamps about eighteen inches apart at the focus of the curve, a complex system of direct and reflected light is obtained. The multiplication of reflectors at different angles prevents the streakiness which is usually the result of using plain mirrors; and the general effect is that articles set in any position within the window are bathed in light from every side. At the same time, no light, either direct or reflected from the mirrors, falls in front of the window line; nor are the lamps visible to the public. The stage effect so much sought after is thus retained with a complete absence of glare or harsh shadows. Thus, from the point of view of effective illumination, it is a matter of indifference how the articles in the window are arranged. The window-dresser is free to follow his fancy, and to alter the character and arrangement of his display at any time with complete assurance that the illumination will remain perfect.

This method of lighting has already been put to the practical test in the window-lighting of large drapery establishments and has proved completely successful. Moreover, it is adapted to the present lighting regulations, which prohibit the overflow of light on to the pavement.

Numerous other applications of this ingenious system of reflectors might be suggested. Stage lighting is one of the most obvious; and in happier times than the present it will find its use for poster and sign illumination.

CATALOGUES, PAMPHLETS, &c., RECEIVED

MOTOR CONTROL PILLARS.—A new list is issued by the British Westinghouse E. & M. Co., Ltd. (Manchester), describing their steel-clad motor control pillars for direct current motors. This type of pillar consists of a cast-iron base which supports the frame on which the switch panels are mounted, the top is also of cast-iron and the sides are enclosed in a sheet steel case with hinged glazed doors in the front. The cable entries are through a large hole in the base casting, which necessitates the provision of a cable trench, but alternatively the base can be drilled to receive conduit or gas pipe, or cable clamps for armouring can be fitted, providing particulars are given at the time of ordering. The pillar contains starter, main switches of the quick-break type, fuses, contractor-type circuit breakers interlocked with the starter, press-button stop, field regulator, and instruments. Twelve standard combinations of this apparatus are listed.

LIQUID CONTROLLERS.—Hand-operated liquid controllers for use with slip-ring type reversing motors, driving haulages, etc., form the subject of a new list by the British Westinghouse Co. (Manchester). They are constructed for use with stator voltages up to 3,300, stator currents up to 300 amps, and rotor currents up to 750 amps. They consist of stator circuit oil-break switches and liquid resistances for the rotor circuit, with a system of cooling pipes for the latter. The mechanism is so arranged that the oil switches close before any of the rotor resistance is cut out of circuit, thus on first closing the oil switch the maximum possible resistance is in circuit with the rotor windings for "creeping" purposes or drawing the rope taut.

CABLES.—Owing to the somewhat complex nature of standard cable discounts at the present time, Messrs. Pooley and Austin (25 Victoria Street, S.W.) have got out a set of single multiplier figures designed to render the calculation of net cable prices quite a simple matter. They can also supply to cable users a limited number of cardboard slide rules for getting a price per yard or per coil when the price per mile is known.

GENERATORS.—We have received from T. W. Broadbent, Ltd. (Huddersfield), their leaflet No. 1 of catalogue No. 5, describing continuous-current generators. Weights and prices are given of machines from 2¼ kw. to 100 kw., for voltages of 115, 230, or 460.

GAUGES AND SMALL TOOLS.—New lists are published by Ira Miller & Co. (92/94 Paul Street, Finsbury, E.C.), describing their gauges of various kinds suitable for munition workers, turret attachments for repetition work on ordinary lathes, cast iron and brass valves and cocks, and a variety of small hand and machine tools.

LOCAL NOTES

Blackburn: *Electricity Accounts.*—There was a net profit of £3,132 on the electricity undertaking for 1915–16, against £2,348 in the previous year, and £4,687 in 1913–14. The number of units sold for all purposes was 7,829,477, an increase of 4·5 per cent. over the preceding year, the main increase being in regard to power supply. Although considerable new connections have been made for lighting purposes, the total consumption for this purpose has not shown much increase owing to war economies. The increase in the cost of coal was no less than £2,359, or 33 per cent., whilst other materials averaged an increased cost of 20 per cent. for the preceding twelve months. The Department has recently inaugurated a system of maintenance of motors originally hired from the Corporation but since purchased by the consumer, which affords efficient maintenance at a moderate figure and releases capital for other remunerative purposes.

Exeter: *Increased Charges.*—In notifying an increase from 4d. to 5d. per unit for current for lighting purposes, the Chairman of the Electric Lighting Committee points out that the undertaking showed a deficit of £900 last year, and the estimated loss during the current year is £1,250. The Daylight Saving Bill, it is calculated, will mean a reduction of £500 in the income of the Department, against which would be set a saving of coal of about £125.

Grimsby: *Electricity Accounts.*—Notwithstanding a falling-off in revenue of £2,000, due to the lighting restrictions, the Acting Borough Electrical Engineer is able to report a net profit of £1,851 for the year to March 31st, 1916. From this is to be deducted £877 paid to employees on active service, and the balance is to be placed to reserve.

Ilkeston: *Bulk Supply.*—The Nottinghamshire and Derbyshire Electric Power Co. recently made an offer to the Corporation to take over the municipal tramways and electricity undertaking on certain terms. This offer came before the Tramways and Electricity Committee last week, and we understand that it was decided to recommend the Corporation to accept it. According to the local Press, it is not thought likely that there will be any considerable opposition on the part of the ratepayers.

London: *The Battersea-Fulham-Hammersmith Linking-up Scheme.*—The Board of Trade circular urging electric supply authorities to link up their undertakings—referred to on another page this week, and also in our last week's issue—has called forth a mild protest from the Hammersmith Electric Supply Committee. It will be remembered that the Battersea-Fulham-Hammersmith Councils in 1915 prepared a scheme for linking-up their generating stations, but that, as the Treasury refused to sanction a loan except for the effective maintenance of existing supplies, the Hammersmith Council was obliged to withdraw from the scheme, as the L.C.C., under the Treasury restriction, felt unable to sanction the Hammersmith Council's proportion of the capital expenditure. Having regard to the terms of the Board of Trade's letter, however, the Hammersmith Town Clerk has been instructed to re-open negotiations with the Government Departments concerned, and also with the L.C.C. and the Fulham and Battersea Councils.

Sunderland: *Improvement in Load Factor.*—There was a net profit of £1,032 last year, but a noteworthy feature of the year's working is an increase in load factor from 26 to 31 per cent.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The Barcaldine Council (Queensland) propose to spend £6,000 upon an electric lighting system; the New South Wales Public Works Department intends to install generating plant at Port Kembla; a scheme for the electric lighting of Singleton (N.S.W.) is being prepared; and an electrical installation at Alexandria (Victoria) is being considered.

Bradford.—In view of the increasing demands upon the electricity undertaking, sanction is to be sought to borrowing the sum of £100,000.

Sunderland.—The annual report of the Electrical Engineer calls attention to the need for extensions to the generating plant in order that the undertaking may be in a position to deal with the increased demand which it is confidently anticipated will follow the cessation of hostilities.

Miscellaneous

Australia.—The Deputy Postmaster-General at Brisbane requires a power board and accumulators of a capacity of 80 ampere hours. Further particulars at 72 Victoria Street, S.W.

The Victorian Government Railways require 400 signal-lighting transformers. Further particulars at 73 Basinghall Street, E.C.

Australia.—The Port Adelaide Council is to borrow £12,000 for an electric tramway service.

The Deputy Postmaster-General at Perth requires telegraph and measuring instruments, including resistance boxes, Morse sounders, switches, &c. Further particulars at 73 Victoria Street, S.W., and tenders by August 16th. This information is only of use to firms who can cable agents.

Keighley.—The War Hospital Buildings at Morton Banks are to be fitted with electricity. Architects, Moore & Crabtree, Keighley, and tenders to Clerk, War Hospital Building, 40 North Street, by June 10th.

London: *L.C.C.*—The Asylums Committee require supplies of electric lamps. Clerk, 2 Savoy Hill, Victoria Embankment. June 19th.

West Ham.—Three months' supply of electrical fittings for the workhouse. Clerk, Union Road, Leytonstone, N.E. June 22nd.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £140 to £144 (last week the same).

Change of Address.—Messrs. Berry, Skinner & Co., Ltd., have removed from 78 Upper Thames Street, E.C., to "The Switch House," 86 Newman Street, Oxford Street, W., where extensive premises have been acquired. The new telegraphic address is "Ptolemaist Ox," London, and the telephone Nos. Museum 3310 and 3311.

Liquidations.—A compulsory winding-up order was made against the Colston Electrical Works, Ltd., Denmark Street, Bristol, last week. An offer of 12s. 6d. in the £ had been made if the petition for a compulsory order was withdrawn and voluntary winding-up carried out, but it is thought that the assets will realise more than 12s. 6d. in the £.

Creditors of the Phœnix Electric Heating Co. (1914), Ltd., are requested to send particulars of their claims not later than June 17th to the Liquidator, Mr. A. E. Tilley, 8 Stable End, Holborn.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

The Electric Construction Co.—The dividend of 7½ per cent. recommended on the Ordinary shares for the year to March 31 is the highest yet paid. This result is stated in the report to be due to the larger volume of orders which have been handled through the unremitting efforts of the staff and workmen. The reserve has been credited with £12,664, and the balance carried forward is £16,839. At the annual meeting in London last week the shareholders were congratulated by the Chairman, Mr. P. E. Beechcroft, upon the improved position of the company, especially in view of the abnormally high prices of materials, the higher rates of wages, difficulties of transport, and other factors which had contributed to the increased cost of production very materially. Speaking with regard to the position after the war the Chairman said he anticipated very considerable extension in the application of electricity in all directions, and did not believe in the views held by some people that employment would be lacking.

Lancashire Dynamo and Motor Co.—The net profit for 1915 was £31,533 against £12,426 in 1914. Reserve has been credited with £14,992 against £2,000 and 12½ per cent. dividend for the year is declared against 8 per cent. The provision for reserve is intended partly to deal with war taxes.

TRADES DIRECTORY OF ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Poulton Bros., Ltd, 38 and 39, Cowcross St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co, Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

FLEXIBLE METALLIC TUBING.
United Flexible Metallic Tubing Co., Ltd., 112, Queen Vict. St., E.C.

HEATING AND COOKING APPARATUS.
Belling & Co., Derby Rd., Edmonton, N.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
The Bastian Elect. Heating Syndicate Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd, 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Record Electrical Co., Ltd., Caxton House, Westminster. S.W.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Phœnix House, King William St., E.C.

LADDERS.
Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

LAMPS (Incandescent)—*contd.*
London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

MOTORS AND DYNAMOS.
British Thomson-Houston Co.. Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons. Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

RUBBER GLOVES.
Ingram (J. G.) & Son, Hackney Wick, N.E.
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SUMMARY

THE horse-power rating of internal combustion engines for driving generators formed the subject of a Paper read before the Association of Supervising Electricians on May 30th, by Mr. W. A. Tookey. He advises engineers not to depend on ratings given by manufacturers, but to deduce the horse-power capacity from standard figures for cubic feet of piston displacement per minute for each kilowatt generated by the dynamo (p. 216).

AT the annual general meeting of the Association of Consulting Engineers reference was made to the fact that the Government, by refusing municipal borrowings, had taken away a large part of consulting engineers' practice (p. 216).

AN article by Mr. A. G. Ramsey discusses the causes of electrical disturbances in H.T. transmission systems (p. 217).

OUR Questions and Answers page this week deals with the question of the size of the neutral conductor in D.C. three-wire, and three-phase four-wire, systems (p. 219).

SEVERAL specifications relating to telephony were published at the Patent Office last Thursday. A patent for magnetic separators for paper pulp machinery has been granted in spite of opposition. Patents in connection with incandescent lamps, electrodes, and telephony expire this week after a full life of 14 years (p. 220).

SOME illustrated notes are given of the latest forms of a well-known make of turbo-alternator (p. 220).

A PAPER on electrical research in engineering colleges has been contributed by V. Karapetoff to the American Institute of Electrical Engineers. It contains some excellent general hints on the subject (p. 222).

A MODERN theatre lighting installation is described and illustrated (p. 222).

LARGE profits and greatly increased outputs are reported by the Electricity Departments at Manchester, Birmingham, and Leeds.—The Ilkeston Corporation has decided to sell its electric lighting and tramway undertakings to the Notts and Derbyshire Power Co. (p. 223).

A £35,000 extension scheme has been prepared at Belfast; a loan of £5,620 is proposed at Wakefield; £1,400 is to be applied for at Loughborough; and £1,500 at Edinburgh. Electrical fittings are required by the Guardians at Brighton and Hull (p. 224).

1st LONDON ENGINEER VOLUNTEERS

ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Platoon Commander N. E. Brown.
Next for Duty.—Platoon Commander C. H. C. Bond.
Resignation.—Platoon Commander E. L. Sanderson resigns his appointment (June 5th).
Monday, June 19th.—Technical for Platoon No. 9, 46 Regency Street, S.W. Squad and Platoon Drill, Platoon No. 10. Signalling Class and Recruits.
Tuesday, June 20th.—School of Arms, 6—7. Recruits, 7.15—8.15.
Wednesday, June 21st.—Lecture "Sketching and Reconnaissance," Mr. R. J. Finch. Platoon Drill, No. 3 Platoon.

OBITUARY

SILVANUS P. THOMPSON, F.R.S.

PROF. SILVANUS P. THOMPSON, F.R.S., passed away on Monday at his private residence in West Hampstead. He was at the Finsbury Technical College on Saturday attending to his ordinary duties, but suffered a stroke later in the day, from which he never recovered.

The death of Professor Tompson, happily without suffering, at the age of sixty-five years, removes yet another of those who did so much to lay the foundations of the electrical industry. He is principally known, of course, in connection with his work on dynamo electric machines, and as far back as 1883 he established himself as, at any rate, one of the leading authorities on this subject. His treatise on the matter published in that year became a standard work, and ran into several editions. Likewise his "Elementary Lessons in Electricity and Magnetism" had a remarkable sale in Great Britain, besides being translated into many foreign languages. This recalls Prof. Thompson's ability as a linguist, and his feat of delivering an hour's lecture on Faraday in the German language in 1901 is one which received much commendation at the time.

Prof. Thompson from the time that he graduated showed a preference for science, and after occupying the post of Science Master at York, subsequently took up the post of Professor of Experimental Physics at the University College, Bristol, and it was from this period that his important contributions to scientific development really date. It was in 1885 that he removed to London to fill the Chair of Physics at the City and Guilds Technical College, Finsbury, where he was also Principal at the time of his death. He was a prolific writer and lecturer, and read many Papers before the Institution of Electrical Engineers, of which he was a Past President, the Royal Society of Arts, the Royal Society, Royal Institution, Physical Society, Illuminating Engineering Society, Röntgen Society, and others.

Apart from his work on dynamo-electric machines, Prof. Thompson's studies covered an exceedingly wide range of physics and optics. His activities were so great that he enjoyed an international reputation not only by reason of his written works, but on account of his personal associations with those foreign countries which can claim to lead in the scientific world. His own scientific attainments are far too great for us to do justice to in these few notes. The older school of electrical engineers need no reminder of them, whilst the younger members of the profession know him well enough by his speeches at meetings of the Institution and elsewhere, and by study of his works. As a man, his loss will be mourned no less than as a scientist. His nobility of character and gentleness of manner endeared him to the vast circle of scientific and social friends. His abhorrence of hate and bitterness led him to detach himself from many of his colleagues on the Council of the Institution on the question of the expulsion of alien enemy members, although his views on the matter of war were so well known from his life-long association with the Society of Friends, that the speech which he made at the Institution on the occasion of the meeting to consider the course to be adopted with alien enemy members was never misinterpreted, at any rate, by those who knew him best.

A meeting for worship will be held at the Friends' Meeting House, 52 St. Martin's Lane, W.C., to-morrow, Friday, at 3 p.m. (after cremation), and all friends who can are asked to attend.

For Arrangements for the Week see p. 224.

THE RATING OF GAS ENGINES FOR DRIVING GENERATORS

IN a very practical paper on "Internal combustion driven electrical sets," read before the Association of Supervising Electricians on May 30, Mr. W. A. Tookey dealt with the subject of the horse-power rating of internal combustion engines, paying particular attention to the overload question. One very frequently hears that a gas engine should be selected to work at a load 15 per cent., more or less, lower than the maker's ratings. This presupposes, says the author, that gas-engine makers have agreed upon a standard basis of rating amongst themselves, but, as far as he is aware, this is not the case. Practice in this matter varies very considerably, and while an allowance of 15 per cent. may be required in some cases, in others it would penalise a maker who rates his engines more conservatively with the intention of securing a reputation for reliable operation of his machines, even under adverse circumstances, as compared with competing designs.

In makers' lists several qualifications are given to the term "H.P." They are so well-known that they need not be repeated, but there is one important item which a maker's catalogue very rarely gives, and that is the diameter of the engine piston and its length of stroke. Why this information should be omitted is difficult to justify, as it is upon this dimension that the whole output of the engine depends and comparisons are made possible. In his practice, the author pays no regard whatever to the maker's ratings, and considers only cylinder dimensions, and he advised all supervising electricians to adopt the same course. Knowing these, the engineer can select his own engine to suit the job, and allow such margin as he thinks is necessary. Then, knowing the speed of rotation of the engine crank shaft, and the limit of pressure behind the piston that it is advisable not to exceed, he has all the elements which enable him to exercise a wise discretion in making a selection from engines of various types and construction.

The author then gives a long table of information concerning internal combustion engines for use with various kinds of fuel, in which he finally deduces the cubic feet of engine piston displacement per minute that must be allowed for each kilowatt generated by the dynamo if the output required is to be "maintained for several hours on end." If the set is to continue in operation throughout the whole of the twenty-four hours, he increases this necessary piston displacement by about 10 per cent. With such an additional margin of 10 per cent., says the author, one can feel sure that temporary derangements, say of valve setting, which may result in reduced power from the engine, or temporary abnormalities such as reduced strength of gas mixtures, or of increased engine friction, due possibly to slightly heated bearings, or of any similar occurrence due to operation, will not affect the running to such an extent as to produce either a slowing-up of the engine, or of actual stoppage under full load.

To show the practical application of the figures given in the table, one or two examples of their use are given :—

(a) An engine has four cylinders, each 8 in. diameter and 7 in. stroke, and runs at a speed of 600 revolutions per minute. It is served with town gas. What is its output capacity in k.w. as a normal working full load?

Answer :—Area of 8-in. piston = 50 sq. in, piston displacement = $50 \times 7 \div 1728 = 0.2025$ cubic feet, V_w (displacement per minute per k.w.) = 4.5 cubic feet. Therefore :— $0.2025 \times 600 \times 4 \div 2 \times 4.5 = 54$ k.w., is the required capacity. Or for longer periods of operation at full load say 50 k.w.

(b) A four-stroke two-cylinder engine, 5 in. diameter and 6 in. stroke, and specified to run at 800 revolutions per minute is worked on kerosene (refined oil), and is offered by the makers as a suitable engine to drive a dynamo for eight hours at full output of 100 amps. and 135 volts, and to be capable of giving a first battery charge for twenty-four hours. Is this a fair rating?

Answer :—Area of 5-in. piston = 19.6 square in., k.w. output $100 \times 135 = 13.5$ k.w., piston displacement = $19.6 \times 6 \div 1728 = 0.068$ cubic feet. Therefore displacement per minute per k.w. $(V_w) = 0.068 \times 800 \times 2 \div 2 \times 13.5 = 4.0$. But the table shows that for refined oil engines V_w should equal 6.1 cubic feet displacement per minute per k.w., and therefore a three-cylinder engine of the same cylinder dimensions and speed would be necessary to give adequate margin.

After giving other examples, the author said he had dealt with the calculations at some length, as he felt that it was to the shirking of what are, after all, but simple examples of arithmetical problems, that troubles with internal combustion driven dynamo sets are often due. There can be no question of the importance of the subject to supervising electricians, who are from time to time faced with considerations of the description implied in the above examples. The subject is not theoretical, but essentially practical, and should certainly be given much more attention than it usually receives.

ASSOCIATION OF CONSULTING ENGINEERS

THE annual general meeting of this Association took place on Wednesday, May 21st, Mr. G. M. Taylor presiding.

The Chairman said the year, as the Committee's report stated, had been one of depression for the consulting engineering profession, and the Committee, therefore, had had a year of patient watchfulness, during which nothing of startling importance had occurred. Practically with a stroke of the pen the Government, by refusing municipal borrowings, took away a large portion of the consulting engineers' practice, and though no loyal member of the Association wished to grumble, because where the interests of the country were at stake and the best means of carrying on the war had to be considered, their private interests must stand aside; still, it had had a great effect on the profession generally, and hence the Committee had not had the amount of work which they might have had if the profession had been in a prosperous condition. There was a matter which he thought might with advantage receive the further consideration of those in authority. All engineering work passing at present through the shops of controlled firms was under the Defence of the Realm Regulations placed either in Class A, B, or C, A being reserved for munitions of war; B for work in connection with the production of munitions; and C for all other work. It followed from this that plant for export, which would be the means of bringing money into this country, had no preference over orders for material required for ordinary purposes at home, which, very rightly, was given no preference. It certainly appeared to him that there was need for a third class between B and C into which could be placed all work which, whilst not directly connected with the supply of munitions, was of such a nature that it was in the interests of the nation that it should receive attention immediately after that work. If such a class was instituted, facilities would have to be accorded as regards railway transport and shipment. While the first consideration was the production of all materials necessary for the successful prosecution of the war, surely the next thing was to carry on our export trade and to attract into the country money from outside sources. As it was at present, there were a number of foreign contracts in a half-finished state, for the completion of which the payment of large sums of money from foreign sources was held up. One matter mentioned in the report was the employment of municipal officers outside their own districts. He did not suggest for one moment that these engineers were not perfectly competent to advise on outside engineering questions, but it seemed to him that their time should be fully occupied in carrying out their own special work. A case was taken up by the Association, although the engineer who brought the facts before them was not a member. They thought it was a case where the Association might reasonably suggest that there could be found amongst consulting engineers one acquainted with the local conditions.

The report and accounts, which latter showed a balance of £128, were adopted.

The new members of Committee elected were :—A. A. Campbell Swinton, Frank Gill, Wm. Vaux Graham, E. P. Hill, Arthur Hindle, Charles D. Lomax.

The honorary officers were re-elected, and a hearty vote of thanks to the Chairman closed the proceedings.

Organisation of British Engineering Industry.—The following resolutions were carried at a general meeting of the Council (Manufacturing Engineering Concerns Section) for the Organisation of British Industry on June 6th :—

That this meeting approves the steps taken to organise British engineering industry by the Council appointed on December 6th, 1915.

That this meeting approves the formation of an association on the lines advocated in the memorandum circulated, with power to negotiate, and if advisable to amalgamate or combine with existing or projected associations, and this meeting pledges itself to support such an organisation.

That those firms who by signing the card have promised their adhesion and support to the organisation, be asked to subscribe to the funds of the new association, and to make forthwith a minimum payment of £5 on account of their first year's subscription towards preliminary expenses.

That the existing committee be empowered to give effect to the resolutions passed at this meeting.

We gave details of the scheme referred to above in ELECTRICAL ENGINEERING for Nov. 25th, 1915, p. 468.

ELECTRICAL DISTURBANCES

By A. G. Ramsey

It is agreed among the leading authorities of to-day that the main problems of protection of electrical apparatus and of high-tension transmission lines have been solved, but there still exist many points to be cleared up and there is much in the realm of theory, especially with regard to atmospheric phenomena, which has yet to be touched. In the following outline only a few of the main divisions of electrical disturbances, which more or less predominate, have been considered.

Briefly, electrical surges may be classed into two main groups: potential surges and dynamic-current surges. The former kind of surge naturally involves movement of a charge of electricity, and is therefore followed by a current. It is necessary to distinguish this surge current from the heavy dynamic currents which result on a constant-voltage system from an accidental short-circuit. There is, of course, always a greater amount of energy in the dynamic-current surge, which frequently causes great mechanical damage and excessive heating. The resulting oscillating currents of abnormal potential surges rarely do harm in themselves; it is the abnormal value of the potential reached which so often causes the destruction of the dielectric.

The principal causes of abnormal potential surges are lightning, accidental grounding, resonance, switching effects, reflected waves, concentration of potential, &c., and continuous induction.

Lightning.—The nature of the accumulation of static electricity in the atmosphere which causes lightning is still a matter of speculation. Considering the disruptive strength of air, the distance travelled by lightning flashes in the clouds, and their character—quotes Dr. C. P. Steinmetz—no potential difference can exist of such magnitude as to cause a disruptive discharge across a mile or more of space. It seems very probable that, as a result of very rapid condensation of moisture and the lack of uniformity of this condensation due to air currents, a non-uniform distribution of potential is produced between the rain-drops in the clouds. When, at some point in space, the potential gradient exceeds the disruptive strength of air, an oscillatory discharge will take place between the rain-drops, and gradually, in a number of successive discharges, traverse the cloud and equalise the potential gradient within it. It may be mentioned here that lightning flashes usually occur within thunder clouds and only rarely from cloud to cloud or from cloud to ground.

From the results obtained by F. Linke in numerous balloon ascents, the potential gradient appears to diminish the farther we get away from the earth. Up to 1,500 metres it seems to vary from day to day and to depend on the atmospheric conditions, but above this height the gradient at any particular point tends to remain constant over long periods. Linke deduced the following formula :—

$$av/ah = 34 - 0\cdot006h$$

where dv/ah is the potential gradient in volts per metre, and h the height in metres above the ground. This formula is applicable to heights from 1,500 to 6,000 metres (*i.e.*, from 1 to 4 miles approximately).

Accepting these conditions and assuming the gradient up to 1,500 metres to be the average of that at the ground in Linke's experiments (125 volts per metre), and that at 1,500 metres (25 volts per metre), it can be deduced that the potential difference between a stratum of air 3,000 metres high and the earth is, under these conditions, of the order of 140,000 volts. Even assuming that Linke's formula is only a rough approximation which fits in with his experiments, the results show that at about 6,000 metres (*i.e.*, 4 miles) above earth the potential gradient is very small. The figure of 125 volts per metre at the ground is very low, and 300 volts per metre is a more general value; in foggy weather this may rise to 1,000 volts per metre.

Observations during a thunderstorm have, so far as the author is aware, not been taken, but the distribution of potential at such a time would be very erratic, and it is impossible to fix any limits to the variations of the potential. During storms the gradient near the earth is at least ten times that during settled days. There is a record of a lightning flash of over two miles in length, and, if we assume that the mean electric stress necessary to cause discharge is of the order of 80 kilovolts per inch, and allowing for a certain amount of ionisation in the air, at least 8 to 10 million kilovolts would be required to produce this. This example serves to confirm Dr. Steinmetz's opinion, quoted earlier in this article.

Briefly, lightning may effect a transmission line in three ways—by static induction, by magnetic induction, or by direct stroke. A charged cloud approaching a line induces, by static induction, a charge of opposite sign in the conductors, and if the cloud suddenly discharges to ground the line is left charged to a high potential. This charge essays to escape to earth, and, if the line be well insulated, it rushes along until it reaches the apparatus connected to it, and jumps to earth if there is a weak spot at this point. If, however, the insulation is everywhere strong enough to prevent discharge, or if the potential of the charge is not high enough to jump to earth, the charge will oscillate backwards and forwards along the line, dissipating its energy in ohmic losses and leakage.

When a lightning discharge takes place parallel to a transmission line the field set up by the discharge induces a charge in the line by magnetic induction. If the discharge be of an oscillatory nature the induced charge is of the same character, and may either jump to ground at a weak spot or damp itself out as before.

A direct lightning stroke is rare, and if it strike a line at some distance from the station it usually jumps to ground over the nearest insulator, often destroying both insulator and pole. Although this main discharge passes directly to earth, there will generally be a wave sent along the line, which may, or may not, cause damage, according to circumstances depending on local conditions. On the other hand, if the stroke occur near the station apparatus it is very probable that no protection whatever will be obtained from any lightning arrester. Even suppose that the arrester were a direct connection between line and earth, there would generally be sufficient inductance and resistance in this ground connection to prevent a free discharge, and the result would be that the lightning would find other paths to ground, as before. It may be said, generally, that lightning arresters are not required to discharge direct strokes.

It is probable that lightning disturbances may be either oscillatory or impulsive in character, and recent investigations seem to confirm this view. Cloud lightning appears to have wave fronts of various degrees of steepness, and there is no doubt that some of the discharges are distinctly simple impulses and not high-frequency effects. It is calculated that the possible frequency of discharge lies between half-a-million and a million cycles per second; several discharges generally follow in succession, and what appears to the eye as a single discharge usually consists of three to seven, and in rare instances as many as a dozen. These successive discharges are apparently due to a readjustment of charges in neighbouring clouds, and an accumulation of sufficient potential is produced to discharge into that path formed by the first discharge.

Accidental Grounding.—Accidental earths, or "grounds," on transmission lines very frequently cause interruption of service and damage to apparatus. On overhead systems an arc to ground often destroys insulators and burns off portions of the line, while on cable systems the arc quickly burns to the other conductors, thus causing a short circuit. In addition, the rapid make and break of the arc sets up dangerous high-frequency disturbances. It will be as well to consider briefly both isolated and earthed neutral systems, as the conditions are somewhat different in the two three-phase cases. The usual location of these arcing grounds is at an insulator, transformer bushing, transformer or generator end-coil, or a cable joint. If on an isolated neutral system a ground occurs on one phase at the instant when the voltage is a maximum (*i.e.*, at the wave-peak potential), the other phases rise from star potential above ground to delta potential. As this change takes place suddenly, the voltage may rise momentarily to a value of the delta *plus* star potential, *i.e.*, to about 1·58 times delta or 2·7 times star potential. If the flash-over occur over an insulator the current in the arc will be limited to the capacity current of the system, as the return is over the electrostatic capacity of the other lines. The arc tends to be of a high-frequency oscillating nature, and on an isolated system it is, therefore, liable to produce high-frequency disturbances. This danger will be reduced in the higher voltage systems, as the capacity to ground will be much greater, owing to the increased height of the conductors above the earth. The higher capacity also tends to keep the frequency of the disturbances below those frequencies which are liable to cause resonance. In the earthed neutral system the arc following a flash-over constitutes a short circuit, and is thus less liable to become oscillatory; it is, however, far more destructive, owing to the practically unlimited power behind it. If no arcing ground protection (such as an arcing ground suppressor) is provided on an isolated system, the arc will most likely continue for some considerable time, and finally destroy the line-insulator; on the other hand, the high-power arc in an earthed system may often be interrupted by the circuit-breakers, provided the time lag is not great, before much damage is done. Several cases have been noted where an accidental arc has been sustained for a considerable time at one part of a system, without causing damage to the insulation elsewhere, while a ground occurring at another part of the same system has destroyed the insulation of the other phases, with a consequent short circuit. Whether resonance due to accidental grounding occurs or not, practically depends only on the local conditions of the line.

Resonance.—It is well known that a circuit containing capacity

and self-induction has a natural periodicity of its own, and oscillations may be produced in it if the resistance does not exceed a certain limit. If the frequency of the supply be the same as the natural frequency of the circuit, then very violent oscillations may be set up in the circuit and exceedingly high potentials reached. The magnitude of these oscillations is limited by the "apparent" resistance (R) of the circuit, and if this latter is comparatively small, the voltage across the capacity or self-induction may rise to approximately pL/R or $1/pKR$ times the e.m.f. of the supply. (L=self-induction, K=capacity, and $p=2\pi \times$frequency.) The most general cases of resonance in practice occur with long unloaded cables connected to an alternator or transformer, and, in multiphase systems, certain combinations of transformers and cables may exist where, during switching or an open-circuiting of one connection, the self-induction of the transformers may be in series with the capacities of the various feeders. Generally it may be said that resonance of the fundamental and lower harmonics is very rare, but with the higher harmonics resonance is frequently observed, but usually no dangerous pressure rises are caused, owing to the amplitudes of the harmonics being very small.

Switching Effects, Reflected Waves, Concentration of Potential, etc.—A study of oscillograph records of various switching operations on H.T. systems—which are, of course, invariably fed by transformers—discloses the fact that the disturbances due to switching are of minimum effect when the circuits are closed on the L.T. side of the transformers. This method of switching is not always available, and the consequent closing of transmission line circuits by H.T. switching often produces severe oscillations. Consider the case of an unloaded line suddenly switched on to the H.T. side of a step-up transformer by closing the H.T. switch. The line capacity is shunted across the transformer, and is charged through the line inductance and resistance. The severity of the disturbance will depend upon the point of the e.m.f. wave at which the switch is closed; if this be at the peak point, full voltage is applied to capacity. Assuming no losses, the potential across the capacity—*i.e.*, the line—may reach twice the normal line voltage; this is, of course, the limiting value of the disturbance and actually, in practice, 60 to 70 per cent. over-voltage is the maximum. Again, if a transformer is switched on at the end of a line, high-tension switching is, of course, essential. The voltage at the end of the line may be 10 or 20 per cent. above normal, and when this is suddenly applied an exchange of stored energy and a rush of magnetising current take place, accompanied by a sudden rise of potential. Similarly, on breaking circuits the interchange of stored energy between the self-induction and capacity produces more or less dangerous oscillations.

The concentration of voltage on the end turns of transformers and generators at the instant of switching is the cause of many failures. The effect is often accentuated by arcing and vibration of the switch contacts, thereby setting up high-frequency oscillations in the transformer leads. Generally the failure of the insulation of unprotected apparatus only takes place after a number of switchings. Another dangerous effect is the building up of the potential at the far end of a transmission line on open circuit by the action of reflected waves. This is the well-known "Ferranti" effect. Oscillograph records show that the danger of the disturbances produced by switching lies more in the high-frequency nature of the oscillations producing steep wave fronts than the extent of the over-voltage itself.

The study of transient phenomena is exceedingly interesting, and from the following it can be understood that transients are necessary to readjust electrical equilibrium. Energy is stored in a system in two forms, electromagnetic and electrostatic, which may be represented by $Li^2/_2$ and $Ke^2/_2$ respectively, where e is the potential, i the current, L the self-induction, and K the capacity. If the potential and current change it follows that the energy stored in the system must also change. Without an infinite supply of power available, such a change cannot occur instantaneously, and a definite length of time is necessary to effect the variation. Hence the transient. The transient which transforms energy from electrostatic to electromagnetic, or *vice versâ*, is called an oscillation. In "free" oscillations no energy is supplied to the circuit from outside sources, and the e.m.f. and current are in quadrature. The fixed amount of stored energy in the circuit continually changes from electromagnetic to electrostatic, and *vice versâ*, and during the process losses occur through ohmic resistance and leakage, so that the original amount of energy decreases, and finally disappears.

Considering a free oscillation where no losses occur, all the energy at one instant is electromagnetic and equal to $Li^2/_2$, and at some time later it is all electrostatic and equal to $Ke^2/_2$. As there are no losses it follows that $Li^2/_2=Ke^2/_2$, hence, $e/i=\sqrt{L/K}$.

$\sqrt{L/K}$ is called the "natural impedance" of the circuit, and is of great importance in the study of transients. So far as is known it may be taken to represent the ratio between voltage and current of an oscillation. Other transients, besides oscillations, exist which transfer energy into the circuit into which they enter, and from the circuit they leave, and in such cases the current and voltage are in phase; these transients are called "travelling waves." When these travelling waves reach the end of the line both the voltage and current are reflected back, the reflected voltage wave having the same direction as the incident wave, thus increasing the amplitude momentarily to $2e$; the reflected current wave, however, is opposite in direction to the incident wave of current. Generally it may be said that transients of complex electrical circuits are combinations of oscillations and travelling waves.

Continuous Induction.—A telephone line situated under a high-tension transmission line is continuously subjected to potential strains through both electromagnetic and electrostatic induction. If a ground occur on one phase of the transmission line the severe induced voltage in the telephone line will very probably cause considerable damage. On multiphase unearthed systems a ground on the H.T. side of a transformer may induce very high potentials in the L.T. windings unless the latter is earthed or connected to an electrostatic condenser of much greater capacity than that between the H.T. and L.T. windings.

Finally, the effects of short-circuits and dynamic-current surges generally result in excessive mechanical strains and overheating in the apparatus, and may cause an interruption of service. Such effects are often accompanied by abnormal potential disturbances, some well-known examples of which are as follows:—When a heavy current arc "explodes," the sudden cessation of current produces an electromagnetic "kick" which raises the potential to an abnormal value. A short-circuit on one phase of a multiphase generator or transformer causes a distortion and sudden increase of the flux threading the other phases, with the result that dangerous potentials may be reached, especially so on no-load. Similarly, a sudden change in load may produce rises in potential, but of less magnitude and harmful effect than those due to a short-circuit.

In the foregoing account of electrical disturbances no attempt has been made to introduce mathematical proofs, as these can be found in excellent form in numerous articles and papers published during the last few years. In all cases certain assumptions have to be made, but there is no doubt that the results deduced, if not absolutely correct, serve to indicate the conditions met with in practice.

Turbo-Generator Progress.—The National Electric Light Association of America recently met in Chicago for its annual convention, and the report of the Committee on prime movers contains some interesting facts concerning the development of steam turbines and generators. According to the *Electrical World*, it was stated that the Detroit Edison Company has placed an order for a 60-cycle Curtis turbine rated at 45,000 kw. at 90 per cent. power-factor on 50,000 k.v.a. The unit will consist of a single floor design, direct connected to a single generator. Mention was also made of plans being considered for turbines to operate on a steam pressure approximating 500 lb. per square inch. The Committee presented a contribution by Robert Cramer, an authority on thermo-dynamics, which outlined the problems that higher steam pressures involve It was pointed out that while it is hardly reasonable to expect the general introduction of pressures as high as 1,500 lb. per square inch, pressures of 400 lb., 500 lb., and even 600 lb. seem to be in immediate prospect. The Babcock & Wilcox Co. was reported as having declared that if the demand for boilers capable of operating at 500 lb. or 600 lb. pressure is great enough, they can be turned out as commercial apparatus. The difficulties incidental to adopting higher steam pressures, the boiler manufacturer pointed out, will probably be related to apparatus entirely outside the boilers and furnaces.

1st London Engineer Volunteer Corps.—Attention is called to the facilities offered in this Corps for those who are either over military age or for any reason exempt from military service. The Corps has been formed by the amalgamation of the Engineering Institution's Volunteer Training Corps with the 4th Battalion Central London Regiment (Architects Corps) and the L.C.C. Training Corps. The three Corps have now become an Engineer Corps, and with the exception of the Post Office Engineering Volunteer Training Corps (which is composed of Civil Servants), it is the only engineering corps in the Metropolitan area. The necessity for every man who is not actually employed with the Naval or Military Services, and all men who may be employed on munitions or other work, for joining a volunteer corps, is pointed out in a circular, as also is the fact that information can be obtained from the Adjutant, Chester House, Eccleston Place, Victoria, S.W.

Enemy Firms Wound Up.—Orders have been made by the Board of Trade under the Trading with the Enemy Amendment Act, 1916, requiring the winding up of the Union Electric Co., Ltd., 47 to 57 Park Street, Southwark, S.E., and the Quarzlampen Gesellschaft, 62 Red Lion Street, W.C., dealers in quartz lamps and accessories. The controller in the case of the Union Electric Co. is P. D. Leake, 25 Abchurch Lane, King William Street, E.C., and in the second instance, Mr. R. W. Brown, 12 Old Square, Lincoln's Inn, W.C., is acting.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,498.

I am in charge of the electrical plant at a large works. The current is supplied to us at 6,700 volts 3-phase, through an over-head line, from a step-up to a step-down transformer, the star-points of which are not earthed. If an insulator breaks on one of the phases the switch trips out and cuts off the current. The question is, why should the switch trip when only one phase goes to earth?—PELICAN.

(Replies must be received by first post Thursday, June 22nd.)

ANSWERS TO No. 1,496.

When distributor mains are laid for a D.C. three-wire system, three-core cables are used with the neutral conductor generally about half the size of the positive or negative conductor. In the case, however, of three-phase distribution, four-core cables are used, the neutral core being usually made the same cross-section as the phase cores, as at Dublin and other places. If the consumers' loads can be sufficiently balanced on two legs of a three-wire D.C. system so that a neutral conductor of half-section can be used, how is it that with a three-phase system, where the consumers' loads can be connected across three legs, the neutral conductor is not cut down to, say, one-third the size of the phase conductors, as one would expect?—M. J. A.

The first award (10s.) is given to "Arc" for the following reply :—

In a D.C. 3-wire system of distribution, some form of balancer is usually employed, with the result that any inequality between the distribution voltages due to an unbalanced load can be minimised. It is impossible, on the other hand, to alter one of the phase voltages of a 3-phase alternator without varying the three simultaneously; and the symmetry of the voltages is generally maintained as near as possible by adopting a larger size for the neutral conductor, thereby reducing the voltage drop.

Further, it must be remembered that, in general, the phase voltage of an alternator contains a prominent third harmonic, and that in a 3-phase 4-wire system all the currents in the circuits connected between the outers and the neutral contain corresponding harmonics, which add up arithmetically and flow through the neutral conductor. Even if there be no dissymmetry in the load there may be a triple frequency current in circulation unless the load happens to be wholly connected across the three outers. Hence the section of the fourth wire must be further increased to restrict the voltage drop therein to a permissible value. Of course, it does not follow that the neutral conductor has to be the same section as the other cores; the size can only be properly settled by giving each case separate consideration.

No second award is made.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

The Year Book of Wireless Telegraphy and Telephony, 1916. 876 pp. $8\frac{1}{2}$ in. by $5\frac{1}{2}$ in. 29 figures. (London: The Wireless Press, Ltd.) 3s. 6d. net, by post 4s. 1d.; abroad 4s. 8d.

The fourth annual issue of the Wireless Year Book now makes its appearance in spite of the difficulties caused by the war. Standard information, including a *résumé* of the progress of radiotelegraphy, lists and particulars of ship and land stations, laws and regulations of various countries concerning the subject, etc., has all been revised, and, as far as possible, brought up to date. The text of the International Radio Convention of 1912 and the "Safety of Life at Sea" Convention of 1914 are both reprinted. A useful addition has been made in this issue in the form of an index to the laws and regulations of various countries. The original articles this year, which mostly deal with the use of wireless in naval warfare, include "Intelligence in Naval Warfare," by Mr. Archibald Hurd, and "The Allies' Strategy in 1915, by Col Maude. A number of technical contributions is also included, such as "Photo Electric Phenomena," by Dr. J. A. Fleming; "Capacitance, Inductance, and Wave Lengths of Antennæ," by Dr. W. H. Eccles; and "Measurement of Signal Intensity," by Mr. J. L. Hogan, Vice-President of the American Institute of Radio Engineers. A special section is devoted to a consideration of the progress of radiotelephony in the United States during 1915.

Pole and Tower Lines for Electric Power Transmission. By R. D. Coombs. 272 pp. $9\frac{1}{4}$ in. by $6\frac{1}{4}$ in. 163 figures. (New York: McGraw-Hill Book Co. London: Hill Publishing Co., Ltd.) 10s. 6d. net.

Overhead transmission lines are becoming of increasing importance in view of the rapid growth of electricity supply and the discussions now frequently taking place concerning the interlinking of power stations. That there is room for improvement in the engineering construction of overhead lines is shown by the very large number of telegraph lines destroyed by the storms in this country a few weeks ago. The writer of this book is a member of the American Society of Civil Engineers, and the work benefits by being approached from a civil engineer's point of view. The subject of design is first treated, consideration being given to various types of construction, loads due to weather and broken wires, and the materials used for lines. Three chapters are devoted respectively to wooden, steel, and concrete structures, and the subject of foundations for tower structures is treated very fully. On the whole, the book contains a great deal of data, results of experiments and tests, etc., which cannot fail to be useful to the engineer who has to deal with the problem of transmission line construction.

The Principles of Apprentice Training, with Special Reference to the Engineering Industry. By A. P. M. Fleming and J. G. Pearce. 202 pp., $7\frac{3}{4}$ in. by 5 in. (London: Longmans, Green & Co.) 3s. 6d. net; abroad, 3s. 10d.

This book is one that ought to be studied not only by employers and parents, who are the persons most concerned in the apprenticeship question, but also by all who have any kind of interest in the educational and industrial welfare of the country as a whole. The authors have made a long, special study of the subject from an industrial point of view, as well as from the employers' standpoint, both in this country and abroad, and this work is the outcome not of a mere academic study but of actual experience in the training of youths to be skilled artisans and good citizens. Whilst attention is paid chiefly to conditions in England and to the engineering industry, the general treatment and conclusions will be found to be of universal application. The book is divided into four parts, the first of which deals with the place of the manual worker in industry and the economic importance of training to the individual, as well as to the community. In the second part the characteristics required by artisan workers, and the extent to which these are developed by the existing educational system, are considered. The third part is devoted to a discussion of "vocational selection," and emphasises the need for a careful selection of youths according to their vocational fitness. It also points to the extremely haphazard conditions under which boys at present enter industrial work. The fourth part deals in detail with the question of artisan training. Existing methods in various industrial countries are described, and a plan of apprenticeship is developed suitable to modern conditions at home. Finally, an example is given of a system of training developed by the authors in a large British manufacturing organisation.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published June 8th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

13,674/14. **Telephones.** W. K. L. DICKSON. A telephone transmitter designed to obtain great purity of sound, with the loosely-packed microphone material arranged in an annular space, leaving a clear air space on both sides of the centre of the diaphragm, and with a special shaped shield protecting the central part of the diaphragm from direct impingement of the sound waves. (Three figures.)

5,486/15. **Wireless Telephony, &c.** B.T.H. Co. (*G.E. Co., U.S.A.*) A system of controlling alternating currents according to variations in currents of much smaller magnitude, applicable to wireless telephony or telephone relay working, consisting in connecting in the circuit a reactance which is varied by means of controlling coils excited in accordance with the amplified variations of the current in a controlling circuit. (Three figures.)

12,434 and 13,769/15. **Long-distance Telephony.** WESTERN ELECTRIC Co. Loading coils constructed with a core divided up by several non-magnetic gaps to prevent interference with the working of amplifiers on loaded lines due to change of inductance caused by excessive residual magnetism, and to facilitate superimposed telegraph working on loaded lines. The second specification describes a further improved construction using non-magnetic material for the conductors connecting the sections. (Three and four figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps, &c.: F. J. H. RUSTIGE [Searchlights] 2,743/16 (*100,463*).

Distributing Systems, Cables and Wires, Insulating Materials, &c.: BOWDEN and THOMPSON [Protection of cables] 717/15.

Dynamos, Motors, and Transformers: A.E.G. [Transformer for use with mercury vapour rectifiers] 23,505/14.

Ignition: STONE and HORNBY [Contact makers] 17,322/15.

Incandescent Lamps: NISHIMOTO [Metal filaments] 7,829/15.

Instruments and Meters: AUBERT [Current duration meters] 13,869/15.

Storage Batteries: SMITH [Storage batteries for lamps] 7,546/15.

Telephony and Telegraphy: COMPARE [Wireless control systems] 22,807/14; RODRIGUEZ [Printing telegraph] 4,378/14; HEURTLEY [Telegraphy] 7,579/15; AUTOMATIC TELEPHONE MNF. Co. and BATES [Telephone systems] 9,582/15; WESTERN ELECTRIC Co. (*W.E. Co., U.S.A.*) [Loaded telephone lines] 16,393 & 16,479/15, and [Automatic telephones] 1,876/16 (*100,459*).

Traction: BRETTELL (*Leffler*) [Electric railway systems] 2,897/15.

Miscellaneous: WILLIS and COOKE [Electric couplers for organs] 17,974/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Ignition: V. PONS [Sparking plugs] 5,319/16 (*100,482*).

Miscellaneous: C. VAN DEVENTER [Discharging electricity from moving picture film] 6,696/16 (*100,487*).

Opposition to Grant of Patent

A grant has been allowed on the following patent subject to amendment:—

2,865/15. **Separators.** A. J. NEWELL and R. J. MARX. Magnetic separators for removing extraneous matter from paper pulp.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

13,730/02. **Incandescent Lamps.** B.T.-H. Co. (*W. R. Burrows*). Blowing out a hole in the pip end of bulbs preparatory to tubulating.

14,133/02. **Electrodes.** H. BAKER and CASTNER-KELLNER ALKALI Co. Connections to electrodes of electrolytic cells protected from corrosion by interposition of graphite blocks between the metal connectors and the electrodes.

14,136/03. **Telephony.** W. H. GORMAN and A. GRAHAM. Divers' telephones.

The following are the more important Patents that have become void through non-payment of renewal fees.

Switchgear, &c.: B.T.-H. Co. [Printing press motor control] 4,514/06; W. P. BROOKS and A. D. WHITE [Holders for flexible strip wiring] 4,808/06.

Telephony and Telegraphy: M. S. CONNER [Telephone switches] 4,270/09 and [Telephone meters] 4,271/09.

Miscellaneous: OZONAIR, LTD. and E. L. JOSEPH [Portable ozonisers] 4,579/06.

CURTIS TURBO-GENERATORS

A QUANTITY of interesting information, both as regards the steam and electrical portions of the turbo-generator sets made by the British Thomson-Houston Co. at their works at Rugby, is contained in a finely illustrated book issued by that firm. To those of our readers interested in steam turbines, the Curtis turbine is a household word, and we need not go into detail here on the features which have brought this well-designed and well-constructed machine to the forefront. The book before us explains clearly and well, by the aid of excellent diagrams, the theoretical basis upon which the claims of the compound-impulse turbine rest, and that these claims are realised is equally well shown by the efficiency attained by sets in actual use, and perhaps even more conclusively by the extent to which the Curtis turbo-generator has been adopted throughout this country and other parts of the world.

Full details are given of the mechanical construction of these interesting turbines, with views of complete and partly-erected machines, and a good idea is obtained of the completeness with which every detail has been thought out. Of particular interest is the governor gear with its oil-driven "servo-motor" or relay, actuating a camshaft controlling a row of independent poppet valves, each admitting steam to a section of the first-stage nozzles of the turbine. By this method of governing there is no loss due to throttling of steam in the poppet valve, which at any instant may be under the operation of the governor, and full steam pressure is always applied to all loads. An energy governor of a very simple type is also fitted. Just as the steam turbine presents advantages over the reciprocating engine up to the highest steam pres-

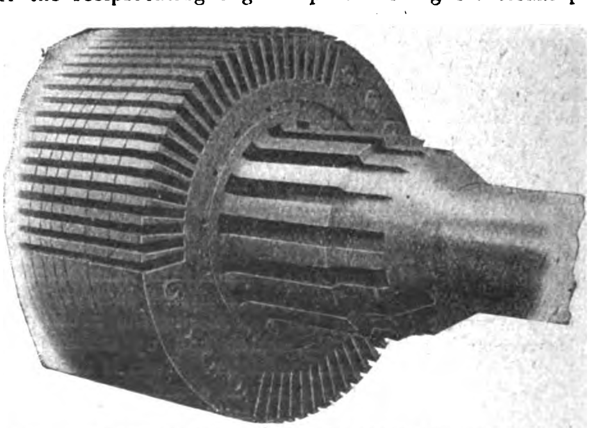

FIG. 1.—GENERAL MECHANICAL CONSTRUCTION OF 2-POLE ROTOR. 7,500 K.V.A., 1,500 R.P.M., 25 CYCLE.

sures with which it can utilise a superheat and vacuum quite out of reach of its elder brother, so it can deal with the lowest pressures which would introduce difficulties of mechanical design in the case of the reciprocating engine. The Curtis

turbine is eminently adapted to such work, and exhaust steam or more generally mixed-pressure turbines figure in a large and increasing section of the sets made.

None the less interesting is the construction of the electrical end of the sets, and we reproduce here a few of the illustrations of details of the alternators, in which the difficulties of design attendant upon the high speeds and compact

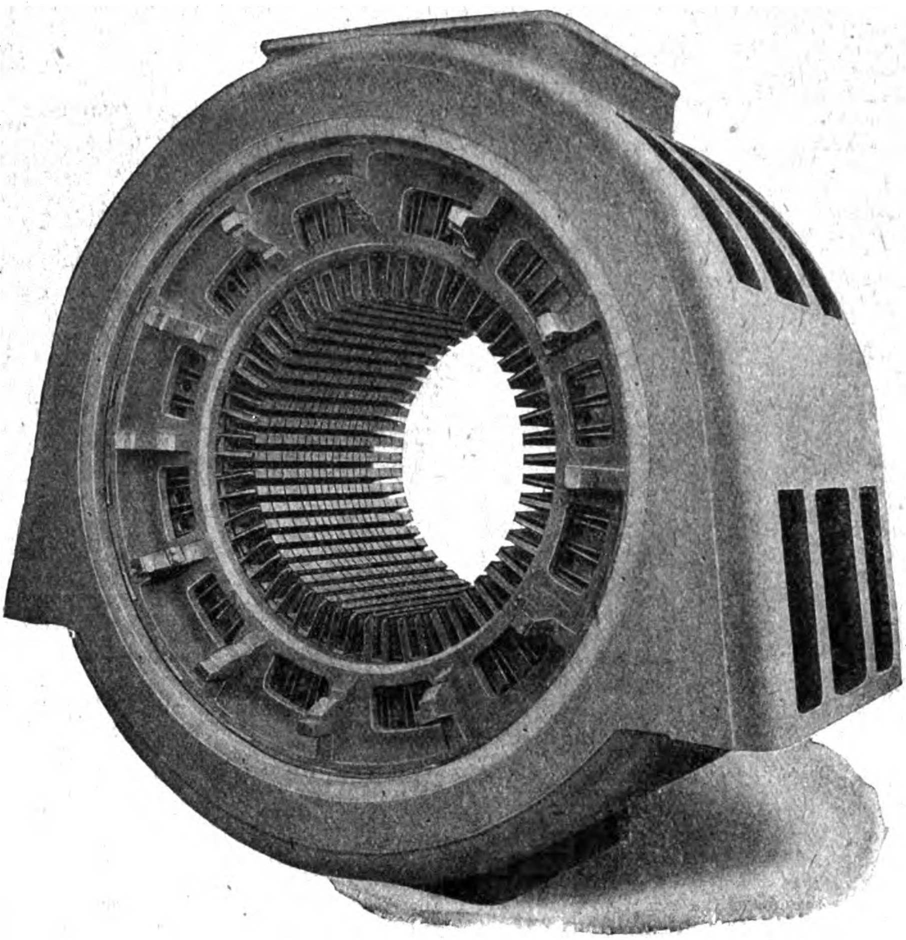

FIG. 2.—UNWOUND STATOR OF 7,500 K.V.A. 25 CYCLE TURBO-ALTERNATOR.

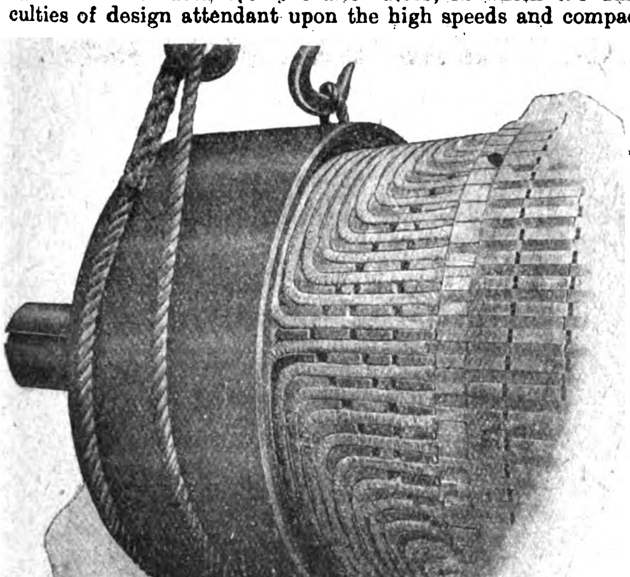

FIG. 3.—END WINDING OF A 2-POLE ROTOR. PLACING A RETAINING RING IN POSITION. 7,500 K.V.A., 1,500 R.P.M., 25 CYCLE.

dimensions are involved. These illustrations give a good idea of the solidity of construction of a high-speed two-pole machine, and refer to a 7,500-k.v.a. 25-cycle alternator. The form of rotor used gives a particularly smooth and symmetrical wave form, very closely resembling a sine curve at all loads and free from ripples, which, especially in the case of long feeders, are apt to give rise to abnormal rises of pressure.

Another interesting detail is a special form of slip bearing, which, by allowing a small amount of play between friction collars, destroys any tendency to cumulative gyration when passing through the "critical speed" during running up. Another important point in an alternator of such small size for its output is the ventilating system, and the question of air-filter construction is also discussed. Geared turbines for driving continuous-current machines, the most efficient speed of which is lower than that of the turbine, are dealt with, as well as direct-coupled sets; and the interesting little volume concludes with an imposing list of localities at home and abroad where Curtis turbines and generators manufactured by the British Thomson-Houston Co. are in use.

ELECTRIC TRACTION NOTES

The accounts of the British Electric Traction Co. for the year to March 31st show a net profit of £189,308, of which £20,327 are placed to reserve, £42,764 are absorbed in the 6 per cent. cumulative participating preference stock, a 3 per cent. dividend upon the ordinary shares accounts for £39,787, and a balance of £86,428 is carried forward. The scheme of reduction and rearrangement of capital has now been approved and confirmed by the Court, and is given effect to in the accounts. The issued capital of the Company now consists of £712,744 5s. in 6 per cent. Cumulative Participating Preference Stock and £1,326,268 10s. in Ordinary Stock. The 5 per cent. Perpetual Debenture Stock and the 4½ per cent. Second Debenture Stock have not been altered by the scheme.

It is anticipated that electric trains will be running on the converted line of the North London Railway Co. between Broad Street and Richmond in September.

ELECTRICAL RESEARCH IN ENGINEERING COLLEGES

IN an interesting paper contributed to the American Institute of Electrical Engineers, Mr. V. Karapetoff gives a list of topics in electrical engineering suitable for thesis, research, and advanced study, and appends some useful general remarks on the subject. Incidentally he makes the statement that America is behind England and Germany in the invention of new types of electrical machinery and apparatus, and in the development of working theories and numerical relations needed in the profession, and to remedy this he advocates the systematising and organising of research. In the course of his paper the author gives the following excellent "advice to the young investigator":—

(1) One who hopes to succeed in invention or research must possess persistence, accuracy, imagination, resourcefulness, good general education (so as to borrow methods from other branches of science), and, in addition, some special knowledge or skill directly pertaining to his problem. It may be experimental skill, dexterity with tools, mathematical ability, knowledge of foreign languages, &c. Often an attempted research ends in failure, not because of alleged external difficulties, but because the student selected the wrong kind of problem—for instance, one requiring experimental ability, when his strong point is library research.

(2) Before taking up a piece of special research, ask yourself if the same time could not be more profitably spent in a study of some more general topic in electrical engineering. For example, would you spend, say, half a year in experimental research of the effect of wave-form of the applied voltage upon the core loss in a transformer, or would it be more useful to put the same time in a study of books and articles on transformers in general, their theory, construction, design, connections, &c.? This question no one but yourself can answer.

(3) Remember that in practically every case you expect to continue the work of others, therefore be particularly careful to find out what has been done, avoid duplication, and give due credit to the preceding investigators. The literature search may be properly begun with the "Science Abstracts," Part B, Electrical Engineering. In some cases Part A, Physics, must also be consulted. The well-known "Engineering Index" and the card catalogues arranged by topics and found in the Engineering Societies' Libraries and in large college libraries are also great helps. The indexes to the leading electrical magazines and transactions should also be consulted.

(4) When planning some research or invention try to think of it in the light of the past and future development of the subject, and not as a detached little investigation of your own. This means that you must connect your work with that of former investigators, and present your results in definite form so that the following investigators can connect them with their work and profit by your labours.

(5) There are problems on which no one is working, either because the situation is premature, or because others became discouraged through lack of results. There is an advantage in working on such a problem. Should you succeed, your credit and recognition will be so much greater. On the other hand, you are much safer working on a problem already staked out by others, where you are merely developing a detail. Some prefer exploring the wilderness, others keep near to beaten paths.

(6) Almost any problem may be made as short and elementary or as long and thorough as is desired, from a superficial undergraduate thesis finished in a few weeks, to an expert's deep research carried on devotedly through a long series of years. Do not "bite off more than you can chew," but whatever you decide to do, do it well.

(7) Do not try to maintain secrecy regarding your work, but try to draw into it and to interest in your problem as many other able persons as you can. Both you and they will be benefited thereby. Consider yourself to be but a thief's apprentice who is learning how to steal nature's secrets, but is not actually doing it yet.

(8) Having made a patentable invention or obtained a patent, do not try to hold it for an exorbitant price. Dispose of it on the basis of a reasonable sum down and a moderate royalty per year or per piece sold. If you have a real inventor's stuff in you, you will make many more important and lucrative inventions. Dispose of your first effort as soon as possible; it will be an encouragement for your further work.

Then follows a list, too long for reproduction here, of suggested subjects which are suitable for research. These are classified under the following headings: Generators and motors, transformers, power plant, transmission lines and cables, electric traction, lighting, industrial application of motors, measuring instruments and methods, radio-transmission, dielectrics, and other miscellaneous problems. The author urges that the Educational Committee of the American Institute shall interest itself in this organisation of research and become a centre for information, co-operating with engineering colleges and with individual inventors and investigators.

ARTISTIC THEATRE LIGHTING

THAT the artistic treatment of theatre lighting has made progress may be seen by comparing the accompanying photographs with one's recollections of the theatres of earliest days. They show the main portions of the Criterion Theatre, Sydney. In the general lighting of the auditorium liberal use has been made of ceiling fittings. There are in all 174 of

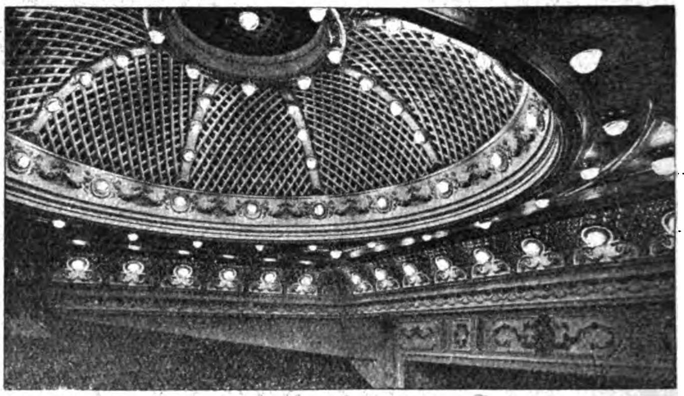

FIG. 1.—THE DOME, CRITERION THEATRE, SYDNEY.

these fittings, 110 being 8 in. Equiluxo hemispheres, and 64 similar hemispheres 12 in. in diameter. The arrangement of these fittings aids the general design by throwing into relief the lines of the dome, and at the same time gives a flood of well-diffused light. Similar fittings are used for the illumination of the stalls, the lamps forming the centre decoration in the ceiling panels.

FIG. 2.—THE STALLS.

Partial use of ceiling fittings is also made in the illumination of the dress circle, but it is confined to the lower portions. Towards the back of the building, where the ceiling is lighter, semi-indirect lighting is adopted with admirable effect. The fittings are of oxidised silver, with Equiluxo bowls and Osram Atmos type lamps. In the boxes fittings of a similar design but with a smaller diameter, are installed.

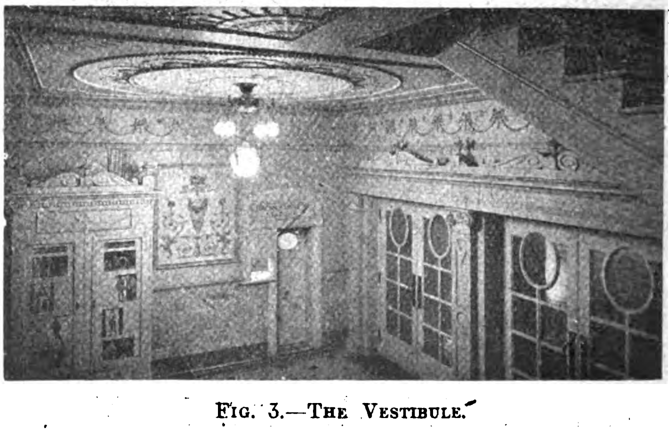

FIG. 3.—THE VESTIBULE.

In the vestibule the fittings are, as will be seen from the photograph, of a more elaborate character. The pendant shown has a large central light, and joins subsidiary lights, each in Equiluxo urns of Doric design. The metal work is in Grecian bronze. Osram Atmos type lamps are again used. On the landing leading to the dress circle another ornate fitting is installed—a gilt colour brass pendant with six lights around

one central globe of "Superlux" glass. Ceiling fittings are again adopted at the side entrance and the top of the stairs. These fittings have a central 12 in. Equiluxo bowl and three subsidiary pendants. They also are made of gilt colour brass. It is said that this installation has made the theatre the best lighted in Australia. From every point of view the illumination has brought complete satisfaction to the proprietors of the theatre. The whole installation, fittings, glassware and lamps was carried out by the British General Electric Co., Ltd., which represents the General Electric Co., Ltd., of Australia.

EDISWAN FANS

ONCE again there is every indication of a good fan season, and those firms that are in a position to supply during the next few weeks will do well to circularise the local hospitals, doctors, nursing homes, authorities, &c. We have received a copy of the latest Ediswan fan list, from which we illustrate a few of their leading lines. Figs. 1 and 2 show the Ediswan steamship and train fan (C.C.) in two different positions. The essential feature of this fan is its special combined supporting device and connection. One or more supports can be fitted in each cabin or saloon, so that the passenger can fix the fan to his own requirements, whilst by means of the swivel and trunnion movement the fan can be set to blow in any desired direction, from the roof, floor, or table. Fig. 3 shows an

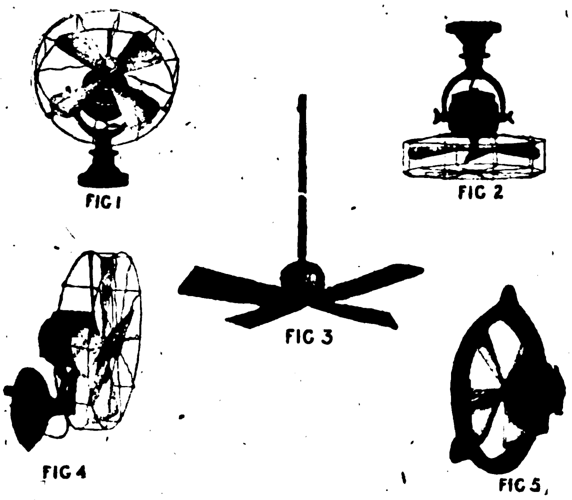

FIG 1 FIG 2 FIG 3 FIG 4 FIG 5

Ediswan ceiling fan (C.C.), which is specially built for large halls, cinema theatres, clubs, institutions, &c. It is capable of energetically moving the air in a large radius without noise. An oil well fitted inside the body prevents oil from getting into the windings, and every part is substantially made from best material. Fig. 4 is the most popular model for convalescent homes, private houses, &c. Being convertible it can be used either as a bracket fan or on the table, floor, &c. It is the most silent fan on the market, and is fitted with a regulator giving three speeds. Fig. 5 illustrates an Ediswan porthole fan (C.C.). This is specially built for factory ventilation, and can be easily fitted to all standing buildings.

CATALOGUES, PAMPHLETS, &c., RECEIVED

ISOLATING SWITCHES.—We have received from the British Thomson-Houston Co., Ltd. (Rugby), their list, No. 4,120, describing isolating switches, type "I," of which there are four forms. Form A is a lever switch, single or double throw, for 11,000-volt circuits, and 200 to 1,200 amps.; form B is similar, but for 4,000 volts; form C is a single throw rotary switch for 200 to 500 amps. at 6,600 volts, and form D is a lever switch for 20 amps, at 11,000 volts. All switches except form D are constructed throughout of wrought copper, except the blocks carrying the blades on form C switches, which are substantial castings. The blades and contacts are carried on white porcelain insulators, presenting a smooth and unbroken surface, which is not liable to mechanical injury, and which can be readily inspected and cleaned.

Electricity Works as Controlled Factories.—We have from time to time referred to the more or less general demand that electricity works should be certified by the Ministry of Munitions as essential to the conduct of the war, and there are signs that this view is now being taken in official quarters. It is calculated, at any rate, to make the lot of the central station engineer a little happier as regards labour. Several supply stations have been so certified, and others are being dealt with gradually on this basis.

LOCAL NOTES

Belfast: *Fatal Electric Shock.*—A foreman electrician named William M'Donald received a fatal shock on Thursday whilst working at a switchboard at the Corporation Electricity Works. This is the first accident of the kind that has ever occurred in connection with the department. The surmise is that the deceased slipped, and, throwing out his hand to restore his balance, inadvertently held on to a live terminal. An inquest was held on Saturday, when the jury found a verdict of accidental death, and expressed the opinion that the use of gloves should be compulsory.

Birmingham: *Electricity Profits.*—There was a net profit of £25,498 for 1915-16, compared with £35,385 in the previous twelve months, after transferring £22,000 to renewals and special expenditure account. The total number of units sold was 117,116,321, against 82,909,182, and the contribution to rates of the balance mentioned compares with the £35,385 in the previous twelve months. The motor connections now amount to 106,637 h.p., compared with 76,563 h.p., and this in itself is sufficient indication of the progress the undertaking is making. The increase in output carries with it a decreased average revenue, the average price per unit received being 1·04d. against 1·125d.

Exeter: *Increased Charges.*—Our note last week dealing with the proposal to increase the charges for lighting purposes was inaccurate. The figures quoted as the deficit for last year did not refer to a loss on the undertaking, but to the reduced income from street lighting only. We are pleased to note that the undertaking has never yet made a loss in any year.

Glasgow: *Increased Output.*—In common with other electricity undertakings in industrial centres, the demands of factories have resulted in a very great increase in the output from the electricity undertaking last year, the increase being 30 per cent., and the actual figures about 140 million units.

Ilkeston: *Transfer of Undertaking.*—As already hinted in our columns, the Corporation has decided to accept the offer of the Derbyshire & Nottinghamshire Electric Power Co. to acquire the lighting and tramways undertaking. The heads of agreement provide that the actual transfer shall take place as from September 30th, 1916; that the purchase be completed within two years of the conclusion of peace; and that meanwhile the Company pays interest and sinking fund charges. The Corporation will have the right to repurchase the two undertakings at the end of 42 years on the terms of the Electric Lighting Act, 1888, and the Tramways Act, 1870, respectively.

Leeds: *Electricity Accounts.*—There was a net profit of £17,090 on the electricity undertaking for 1915-16, out of which £8,734 has been expended on works of a capital nature, leaving a surplus of £8,716, compared with £12,171 in the previous year. The position must be counted as satisfactory, having regard to the difficulties under which the undertaking has worked both as to increased cost of working and restrictions upon laying new service cables, which latter alone has resulted in a much smaller number of new consumers than usual. There was, nevertheless, during the year an increase of 3·8 per cent. in the units sold, the growth of 26 per cent. in the output for power purposes having more than counterbalanced the decrease in sales for other purposes. Curiously enough, traction shows the largest reduction, namely, 3,855,719 units, whilst for the first time in the history of the undertaking power supply has provided the largest source of revenue.

Lincoln: *Satisfactory Progress.*—There was an increase of nearly one million units in the sales last year, the figures being 2,291,114 and 3,152,831 respectively. This increase was due entirely to sales for power purposes, the lighting output, as a matter of fact, being less by 133,000 units than in the previous twelve months. Notwithstanding an increase in the cost of coal and other materials of £3,861 more than in 1914-15, the cost per unit has actually been reduced from 1·242d. to 1·196d. per unit. There was a net profit of £1,690 after meeting capital charges.

Manchester: *Electricity Accounts.*—There was a net surplus of £29,453 on the working of the electricity undertaking last year, as compared with £34,926 in the previous twelve months. After transferring to renewals suspension account £25,419, the surplus for the year, together with £547 from reserve, making a total of £30,000, has been handed over to the Corporation in relief of rates. The number of units sold was 141,551,699, against 127,735,646 in the previous

twelve months. The British Westinghouse Co. have completed another 5,000-kw. turbo-alternator at the Stuart Street works, which involves the supersession of a further Yates & Thom-A.E.G. reciprocating engine set. Pending the commencement of the new Barton power-station, contracts have been placed with Messrs. Richardson, Westgarth & Co. for a 15,000-kw. turbo-alternator, and with Messrs. Babcock & Wilcox for additional water-tube boilers. Other contracts in connection with these extensions have been placed with Messrs. Mather & Platt for circulating pumps and the British Thomson-Houston Co. for extra-high-tension switchgear. A list of 21 firms is given in the annual report upon whose premises sub-stations have been installed. The expenditure before arriving at the balance noted includes £11,110 war-service allowances and £11,308 additional income tax.

St. Helens: *Electricity Accounts.*—Although on account of the lighting restrictions there was a decrease of 18 per cent. in the units sold last year for lighting purposes, and there was also a decrease of 10 per cent. in the quantity sold to the Tramway Company, there was an increase of 21 per cent. in the units sold for power purposes, with the result that the total number of units sold shows an increase of 3 per cent. Having regard to the Daylight Saving Bill and the further restrictions in the way of reduced lighting which the Board of Trade is asking for, the Council was asked at its last meeting to sanction an increase of 20 per cent. in the charges as against the present increase of 10 per cent. There was much opposition to this, however, and eventually the proposal was referred back.

Salford: *Increased Profits.*—The net profit on the electricity undertaking last year was £16,000, the largest made in the history of the undertaking, the figure for 1914-15 being £8,000. This result has been mainly brought about by the installation of more efficient plant, which alone has effected a saving of 15,000 tons of coal per annum; and, but for the increased expenditure brought about by the war, the net profit would have been £28,000. The total number of units sold was 24 millions, which represents an increase of 20 per cent. over the previous year.

Sutton Coldfield: *Purchasing Wiring Contractor's Business.*—The principal of Messrs. Clive & Co., electrical wiring contractors to the Electricity Department, having decided to join the Forces, the Electricity Committee has arranged to take over the stock, fittings, &c., and carry on the business.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Aberdeen.—In connection with the supply to Messrs. John Lewis & Sons' shipbuilding yard, the necessary high-tension main is estimated to cost £1,500, and the consumption of the firm is to be, as a minimum, an amount equal to 20 per cent. of the capital cost of the cable. The firm is also to provide a sub-station, from which three-phase 400-volt A.C. supply will be given.

Belfast.—A deputation is to be sent to the Local Government Board as to a scheme of extensions which has been prepared at an estimated cost of £35,000. Differences of opinion on the Council with regard to extensions at Belfast seem still to continue, for there is some opposition to this scheme on the ground that it would be better to wait until happier times, when a more comprehensive proposal should be prepared.

Salford.—Coal conveyors and bunkers are required for the electricity works. Borough Electrical Engineer, June 26. (See an advertisement on another page.)

Wakefield.—A loan of £5,620 is to be applied for in connection with electrical extensions.

Loughborough.—A loan of £1,400 is to be asked for in connection with mains to supply the new engineering works of Messrs. Herbert Morris, Ltd.

Yorkshire.—The Yorkshire Electric Power Co. contemplates considerable expenditure upon extensions at its Ravensthorpe power-station.

Miscellaneous

Brighton.—The Guardians require a supply of electrical fittings. Clerk, Parochial Offices, Prince Street. June 20th.

Bristol.—The Guardians require a supply of electric fittings. Clerk, St. Peter's Hospital. June 21st.

Hull.—Six months' supply of electrical goods for the Guardians. Clerk, St. Mary's Chambers, June 17th.

Salford.—The Electricity Department requires a supply of cable accessories and motor carbon brushes. Borough Electrical Engineer. June 26th.

APPOINTMENTS AND PERSONAL NOTES

The following is the short list of applicants for the tramway managership at Belfast:—Mr. J. S. D. Moffett (West Ham), Mr. W. J. M'Combe (Hull), Mr. R. S. Pilcher (Aberdeen), Mr. J. F. Simpson (Preston), Mr. J. W. Dugdale (Oldham), and Mr. R. H. Wilkinson (Huddersfield). The gentlemen named are tramway managers in their respective towns. The final appointment has been referred to a Sub-Committee of the Tramways & Electricity Committee.

The salary of Mr. E. Cross, Borough Electrical Engineer and Tramways Manager at Rotherham, has been increased by £50 per annum. There was some opposition to the proposal when it came before the Corporation, but a high tribute was paid to the work of Mr. Cross by those members of the Council who come into close contact with him, and the increase was eventually sanctioned.

Two switchboard attendants are required at Faversham sewage pumping station. 30s. per week. Borough Surveyor.

We regret to hear that Lieut. J. R. Wilkinson, son of Mr. George Wilkinson, Borough Electrical Engineer at Harrogate, has been accidentally killed at the Prisoners' Camp at Gnadenfrei, Silesia, Germany. Lieut. Wilkinson, who belonged to the 2nd Lancashire Fusiliers, was twenty-six years old, and had been in the Army between five and six years. He went to the Front in the early part of August, 1914, and was unfortunately badly wounded and taken prisoner during the retreat from Mons. Lieut. Wilkinson fell from a roof at the Prisoners' Camp, from which he was making some meteorological observations, a subject in which he was interested. All friends of Mr. Wilkinson in the electric industry will sympathise with him on the tragic death of his son.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £140 to £142 (last week, £140 to £144).

Liquidations.—The liquidator in the compulsory winding-up under the Trading with the Enemy Amendment Act of the Schorch Electrical Co., of 35 Basinghall Street, E.C., is Mr. C. E. Barker, 21 Finsbury Pavement, E.C., to whom claims should be sent no later than July 14th.

Arrangements for the Week.—*Thursday, June 22nd:* Incorporated Municipal Electrical Association. Annual meeting at Institution of Electrical Engineers, Victoria Embankment, 10 a.m. Presidential address by Mr. A. C. Cramb, Borough Electrical Engineer, Croydon, and Paper on "Boiler House Design," by W. W. Lackie, Chief Electrical Engineer, Glasgow. At 2.30 p.m. the following Papers will be read:—(1) "Area of supply from an economical standpoint," by H. S. Ellis, Borough Electrical Engineer, South Shields; and (2) "The Application of Electric Power to Agriculture," by W. T. Kerr, City Electrical Engineer, Hereford.

Friday, June 23rd: The Incorporated Municipal Electrical Association. Annual business meeting at Institution of Electrical Engineers, Victoria Embankment. 10.30 a.m.

Linking up Electricity Supply Undertakings.—In reference to the article on this subject on p. 207 of our last issue, it is of interest to note that a conference of London municipal electric supply authorities was held at Caxton Hall, Westminster, on Monday, at which the Board of Trade circular was under discussion. Mr. G. Hume, Chairman of the Electricity Committee of the London County Council, commented on the L.C.C. linking-up scheme which was introduced in 1914, but was withdrawn owing to the war, and a resolution was passed assuring the Board of Trade that the authorities represented would do all in their power to carry out the object in view.

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The Government has decided that strict economy in paper is necessary, and, in consequence, to prevent waste, the majority of newsagents and bookstalls will limit their stocks so far as possible to the actual known requirements of their customers. A mere verbal order will, however, be sufficient to ensure that a copy is sent or reserved weekly.

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SUMMARY

WE discuss some phases of the Excess Profits Tax. Some of the London electric supply companies are asking for an increase in the statutory percentage of 6 per cent. to 10 per cent. Tramway companies are asking that it should be increased to 12 per cent. (p. 226).

THE annual meeting of the Incorporated Municipal Electrical Association opens in London to-day under the presidency of Mr. A. C. Cramb, Chief Electrical Engineer, Croydon. In his Presidential Address Mr. Cramb discusses many points affecting the work of the members which have been matters of controversy for many years, such as the Wiring Bill and the model general conditions of contract. He strongly criticises the electrical contractors for not showing a more conciliatory spirit in face of the concessions made by the Association. The Publicity Sub-Committee has been instructed to prepare a complete scheme for the development of a publicity organisation in this country (p. 227).

AN illustrated description of the laying of two 20,000-volt cables by the Glasgow Electricity Department across the Clyde will be found on p. 229.

WE publish abstracts of two of the Papers to be read at the meeting of the Incorporated Municipal Electrical Association to-day. Mr. W. W. Lackie deals with the general principles of boiler-house design and various points to be observed to ensure the most economical working.—Mr. H. S. Ellis covers a large amount of ground in showing up the weak points in the argument of those who advocate wholesale centralisation of electricity supply, and deals with the coal question, works costs, steam consumption of large and small sets, capital expenditure, and transmission losses (p. 230).

THE resolutions with regard to enemy members of the Institution of Electrical Engineers were duly confirmed at a meeting on Thursday. Mr. C. P. Sparks, the President, said that if this did not prove effective, the members had only to approach the Council again to secure further action (p. 233).

THE Glasgow Tramways Department is very satisfied with its women tram-drivers. Women are also employed in the sub-stations and on the power-station switchboard (p. 233).

AMONG the subjects of specifications published at the Patent Office last Thursday were wireless remote control, feeder protection, electric traction, and metal filaments. A patent connected with telephone junction-line working has been granted in spite of opposition. Patents relating to boosters, magnetic clutches, traction, and printing telegraphs expire this week after a full life of fourteen years (p. 234).

OUR "Questions and Answers" Page this week discusses the method of operation of balancer sets for continuous-current distribution on the three-wire system (p. 235).

A PROPOSAL by the Sheffield Electric Supply Committee to take £10,000 from reserve fund for mains extension has been withdrawn (p. 236).

A LOAN of £45,000 has been sanctioned at Greenock, and new generating plant is required at Aberdeen and Wolverhampton. Stores are required at Exeter and Liverpool (p. 236)

For Arrangements for the Week see p. 232.

1st LONDON ENGINEER VOLUNTEERS

ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

(*To-day*) *Thursday, June 22nd.*—Platoon Drill, No. 7 Platoon. Shooting for No. 10 Platoon. Miniature Range. Recruits, 5.45–7.45. Instructional Class, 5.45.

Friday, June 23rd.—Technical for No. 10 Platoon, 46 Regency Street, S.W. Squad and Platoon Drill, No. 9 Platoon.

Sunday, June 25th.—Entrenching at Otford: Parade Victoria (S. E. and C. Ry. Booking Office) 8.35 a.m. Uniform, haversacks, water-bottles. Midday rations to be carried. Railway vouchers will be provided.

Officer for the Week.—Platoon Commander C. H. C. Bond.

Next for Duty.—Platoon Commander J. O. Cheadle.

Appointments.—H. de P. Birkett to be Company Sergeant Major, No. 3 Company. H. J. Golding, P. H. H. Jantzen, and E. A. Ullmann to be Section Commanders, No. 3 Company. All to date June 3rd.

Monday June 26th.—Technical for Platoon No. 9, 46 Regency Street, S.W. Squad and Platoon Drill, Platoon No. 10. Signalling Class and Recruits.

Tuesday, June 27th.—The School of Arms will be discontinued during the summer months. Recruits, 7.15–8.15. Lecture, 7.15, "Organisation and Discipline," Company Commander W. Hynam.

Wednesday, June 28th.—Platoon Drill, No. 1 Platoon.

Thursday, June 29th.—Platoon Drill, No. 5 Platoon. Shooting for No. 9 Platoon, Miniature Range. Recruits, 5.45–7.45. Instructional Class, 5.45.

Saturday, July 1st.—Parade, 2.45. Uniform.

Unless otherwise indicated, all drills, &c., will take place at Chester House.

Science and Engineering.—The Standing Committee on Engineering appointed by the Advisory Council for Scientific and Industrial Research, of which Sir Maurice Fitzmaurice is Chairman, held its first meeting recently. The representative of the Institution of Electrical Engineers on the Committee is Mr. J. S. Highfield. Other electrical members of the Committee are Mr. C. H. Merz, Mr. G. G. Stoney, F.R.S., and Prof. Miles Walker.

THE EXCESS PROFITS TAX

The article from a contributor which appeared on p. 207 of our issue for June 8th on the Excess Profits Tax, having attracted a certain amount of attention, it will be interesting to go into the position a little more fully. The one point dealt with by our contributor is replied to in a letter below, but the problem has many sides to it, the different sections of the electrical industry each having special conditions of their own to contend with.

Part III. of the Finance (No. 2) Act, 1915, deals with Excess Profits duty, and it is provided that where in any accounting period which ended after August 4th, 1914, the profits arising from any trade or business exceeded by more than £200 the pre-war standard of profits, a duty of 50 per cent. will be levied. In the last financial statement of the Chancellor of the Exchequer this percentage is increased to 60 per cent. Where the accounting period is less than a year the figure of £200 is proportionately reduced. The pre-war standard of profits will be the average profits of any two of the three years immediately preceding the war. Alternatively what is termed a statutory percentage of 6 per cent. in the case of businesses carried on by a company or other corporate body may be the basis, or 7 per cent. in the case of other business. Applications, however, may be made for an increase in this statutory percentage.

Probably the most important part of the Act is the fourth schedule, which deals very minutely with the method of computing the profits. This is worth close consideration in view of the schemes that have been propounded from time to time, whereby it is sought to keep the hands of the Chancellor of the Exchequer off the major portion of the profits directly due to the war. The principle of the Income Tax Acts is applied, and this seems at once to cut the ground away from many of the ingenious arguments which have been put forward. May we also suggest that there is a moral as well as a commercial side to this question? Looked at broadly, the engineering industry, and the electrical industry no less than other branches, will have benefited directly in the material sense considerably from the war, even when every penny which the Chancellor of the Exchequer hopes to get has been collected, and, moreover, what is far and away most important, the industry is in a very fair way to be placed on a much sounder foundation than it ever has been. Bearing this in mind, and remembering also the enormous sacrifices which so many members of the community have made for King and country, is the industry quite justified in using every artifice to retain in its own hands at the expense of the country, and those who have been killed and wounded in its defence, the in some cases really enormous profits derived directly from this terrible war? If the industry as a whole can start after the war, as it undoubtedly will do, in a very much stronger position, and with very much better prospects in every way, and at the same time has been able to make during the war profits equal to those earned previously, even granted that these were small, should it matter even if all the profits from war work went into the public funds? At the very worst it means restarting where we left off in August, 1914, and if every one of us could do that we should indeed count ourselves fortunate. The electrical industry, however, should start off under very much happier auspices if the efforts now being made to develop trade in the future are carried to their logical conclusion.

Nevertheless, the Finance Act, as already pointed out, does provide for an increase in the percentage of profit which is to be adopted as a basis, and of course no objection can be urged against advantage being taken of this. As we have already noted, the electric supply companies undoubtedly stand in a special position mainly by reason of their limited tenure, and the necessity for spending capital which at first may prove unremunerative. Mr. H. B. Renwick, managing director of the County of London Electric Supply Co., has taken a leading part in drawing the attention of the authorities to the special position of the electric supply companies. Before the Finance Act of 1915 was passed Mr. Renwick headed a deputation to the Chancellor of the Exchequer, and was largely responsible for the insertion of the clauses under which applications can be made for an increase of the statutory percentage of 6 per cent. We believe there has been some difference of opinion among London supply companies as to the proper course to be taken, but the County of London Company, and some others representing in all four millions of capital, have taken the broad view that for the reasons set out above the statutory percentage should be increased from 6 to 10 per cent., and, indeed, an application on these lines has been presented. On the other hand some other companies whose dividends in 1915 and 1916 were less than their pre-war dividends, at one time felt they were not affected by the Act, and were inclined to take no action. In order, however, to safeguard the circumstances of the London supply companies in respect of possible future legislation, it is not improbable that those companies which at first took the contrary view to the County Company and its associates will modify their view. Of this, however, we have no direct information.

Similarly the Tramways and Light Railways Association has applied on behalf of the tramway companies for an increase of the statutory percentage from 6 to 12 per cent., the reasons being very similar to those put forward on behalf of the electric supply companies.

When we come to the manufacturing side of the industry, the position is a little complicated in that different conditions apply to controlled factories under the Ministry of Munitions compared with those factories which are uncontrolled, and there seems good reason for a certain amount of discontent on the part of those responsible for the former. Controlled factories have to work on the basis of a fixed margin of profit, after which everything goes to the State, whereas uncontrolled factories, working on the basis of excess profits, are regarded as being placed in a more favourable position. Moreover, until quite recently at any rate, the controlled factory was not quite certain as to its relations with both the Ministry of Munitions and the Chancellor of the Exchequer, and whether either or both would have to be dealt with. The principle is the same in all industries, and the machine-tool makers, who felt very keenly upon the point, recently sent a deputation to the Ministry of Munitions and the Chancellor of the Exchequer, with, it is said, satisfactory results, although we have no official knowledge of this. Apparently the fear was that the attempt would be made to apply which of the two sets of conditions as regards profits were the most favourable to the Chancellor of the Exchequer, and it is only reasonable that firms should know exactly their position, and not be left in a state of doubt.

CORRESPONDENCE

EXCESS PROFITS TAX.

To the Editor, Electrical Engineering.

Sir,—I am surprised that your contributor, in his article on June 8 on the above subject, should suggest that it would be possible for a firm to devote £7,000 out of an extra profit of £10,000 to "publicity and foreign representative" work. He has apparently overlooked the section of the Act which states, "Deduction . . . for any expenditure of a capital nature . . . or for the development of the trade or business or otherwise in respect of the trade or business shall not be allowed except such as may be allowed under the Income Tax Acts, and if allowed shall be only of such amount as appears to the Commissioners of Inland revenue to be reasonably and properly attributable to the year or accounting period."

The surveyor would obviously find the expenditure for publicity and foreign representative work to be more than what it was in pre-war years, and I am strongly of the opinion that he would not allow such expenditure.

Yours faithfully,

Manchester, June 14. "Tax Payer."

[The above extract is from section 3 of Part I. of the Fourth Schedule to the Finance (No. 2) Act, 1915. Ed. *E.E.*]

The British Chamber of Commerce for Italy.—The new headquarters are now ready at 7 Via Carlo Felice, Genoa. In connection with these offices are extensive exhibition showrooms, and as the available space is limited firms are advised to apply for the space they require even if they are not in a position to send their exhibits at once. It is pointed out that exhibits should be selected with a special view to business after the war. All information can be obtained from E. B. Weatherhead, Secretary-General, at the above address. We have in our office the terms for space should any firm care to consult them.

German War Profits.—Mainly owing to the large proportion of munition work carried out, the Bergmann Electricity Works Co. doubled its profits in 1915 as compared with the previous year, and pays a dividend of 10 per cent., as compared with 5 per cent. in 1914. The report mentions that the company's holdings in the Société l'Eclairage Electrique of Paris and the Adnil Electric Co. of London, standing at £7,235 and £9,995 respectively, have been written off. The Austrian company is also engaged heavily in munition work.

THE I.M.E.A.

ONCE again, owing to the war, the annual meeting of the Incorporated Muncipal Electrical Association, which is to be held at the Institution of Electrical Engineers' Building, Victoria Embankment, to-day and to-morrow, will be a strictly business affair. As was the case last year, the whole of the usual pre-war social programme has been cut out, but there is a slight modification from the arrangements in 1915 as regards visitors. On that occasion the meetings on both days were restricted to members and official delegates, this course being adopted owing to the nature of the subjects to be discussed.

MR. A. C. CRAMB.
(*The President.*)

This year, however, the Council has extended a few invitations to others than members and delegates to take part in the discussions to-day, but there is no general invitation to visitors. As is always the case, of course, the annual business meeting on Friday will be restricted to members and associate members qualified to vote, and to official delegates of local authorities. With the inability of the railway companies to grant facilities for special fares and the general uncertainty prevailing, it has been decided to leave it to members and delegates to make their own hotel and travelling arrangements. The headquarters of the Association during the meeting will be at the Institution of Electrical Engineers.

The meeting will be under the presidency of Mr. A. C. Cramb (Borough Electrical Engineer, Croydon), who, as senior Vice-President in 1914–15, also acted as President, through the inability of Major Richardson (Chief Electrical Engineer, Dundee), elected to the Presidency at Birmingham in June, 1914, to carry out the duties of the office owing to military duties.

We publish in this issue abstracts of the Presidential Address and two of the papers to be presented to the meeting to-day. The complete programme is given below.

TO-DAY (THURSDAY).

10 a.m.—(1) Presidential Address. Mr. Alex. C. Cramb, Borough Electrical Engineer, County Borough of Croydon.

(2) Paper on "Boiler House Design," by Mr. W. W. Lackie, Past President, Engineer and Manager, Glasgow Corporation Electricity Department.

1 p.m.—Interval.

2.30 p.m.—(1) Paper on "Area of Supply from an Economic Standpoint," by Mr. H. S. Ellis, Borough Electrical Engineer, South Shields.

(2) Paper on "The Application of Electric Power to Agriculture," by Mr. W. T. Kerr, City Electrical Engineer, Hereford.

TO-MORROW (FRIDAY), JUNE 23rd.

10 a.m.—Council Meeting.

10.30 a.m.—Annual General Meeting.

(1) To receive the Council's Annual Report to date and the Auditors' Report and Statement of Accounts for the year ended March 31st, 1916.
(2) To close the Ballot for Officers and Council, 1916-17, and to appoint Scrutineers.
(3) To receive the Scrutineers' Report.
(4) To fix the place of the Annual Meeting, 1917.
(5) To transact other competent business.
(6) Votes of thanks.

1 p.m.—Interval.

3 p.m.—To reassemble if necessary to complete any adjourned business.

PRESIDENTIAL ADDRESS

MR. CRAMB, in his Presidential Address, after recalling that his year of office marks the coming-of-age of the Association, mentions the rather moderate results of the year's work by the various committees, which he feels is quite excusable in view of the number of members who have joined the forces, while others are giving their time and energies to supplying the necessary electric power to meet the rapid and vast expansion of the workshops of the country to satisfy the many demands of the Navy and Army; others, again, are devoting themselves as far as possible to assisting the various organisations for the production of munitions. The Address then surveys the whole field of operations of the Association.

As to the future of electric supply, in this as in most other matters things would never be quite the same again. The electrical industry needs in a greater degree the spirit of co-operation in furthering the expansion of its work for the benefit of the Empire and of its own members, and the need for progress in standardisation, in publicity, in the field of domestic heating and cooking, and in the development of new lines of business offers full scope for the energy of the Association. In some minds the only justification for the existence of municipal electric supply undertakings is their ability to relieve the rates, if not the ratepayers, but the only reason advanced for appropriating electricity profits to this end is compensation for the risks run by the ratepayers in guaranteeing the capital. Frequently, however, the most persistent advocate of charging higher prices for electric supply to relieve rates is not a user of electricity, and the system of relieving rates from profits does not commend itself to Mr. Cramb.

Model General Conditions of Contract.—There can be little doubt in the mind of any member of the Association of the necessity for standard conditions of contract. It is necessary, therefore, that individuals should not press their own personal ideas, one might say prejudices, to the extent of preventing the establishment of conditions acceptable by the majority. If progress is to be made, the mature opinion of the majority must be loyally accepted. Municipal engineers have in the past enjoyed the privilege of making contracts in which the contractor had little voice, and no doubt the settling of contracts in which both sides meet on more equal terms may be somewhat disconcerting at first. The Council have not yet received any report from the Association of Municipal Corporations regarding the contentious clauses of the Model Conditions referred to them for consideration by the I.M.E.A. nearly two years ago. In the meantime, individual undertakings are accepting these conditions, and they have been adopted by the other representative bodies concerned.

I.M.E.A. Bill.—The Association are indebted to the B.E.A.M.A. for their kindly offices in endeavouring to bring about a settlement of the outstanding differences between the Electrical Contractors Association and the I.M.E.A. in connection with this Bill. A joint meeting took place, and it was hoped that an agreement had been reached, but the terms were not accepted by the Electrical Contractors Association. The I.M.E.A. has made concession after concession without avail, possibly going even beyond the limits which justice to the undertakings they represent would warrant. The B.E.A.M.A. have studied the Bill, and expressed themselves satisfied that the conditions are fair and reasonable. Even when contractors are guaranteed in the Bill that all wiring work, which would be greatly increased by the passing of the Bill, is to be placed in their hands, that supply undertakings are to be limited to prices which contractors can safely underquote, and that increased business will be brought about through hire and hire-purchase systems in which there would be no bad debts, they appear to have so little confidence in themselves that they still hesitate to join in a course which holds the promise of a considerable expansion of profitable business. The Association will, at an opportune time, again press for the Bill, and although there may be a further delay, the powers will come, and

possibly in a much fuller form than is now asked for. In the meantime, the electrical industry must bear with what patience it can the contemplation of the large amount of business being lost to gas undertakings which are not so handicapped. It has been the aim of the I.M.E.A. to effect an agreement equitable to the various interests, but it may become necessary to adopt a more active policy to create a greater desire for settlement.

Development Committee.—It is a matter of regret that in view of the important work awaiting this committee, little progress has been made, but members have found it impossible to spare the necessary time during the past year. The work of the sub-committee dealing with questions of electrical apparatus for cooking, heating, and other domestic requirements is urgent and important. There is here a wide field ready for development; it is true the non-passage of the Bill blocks the main possibilities of business, but still much can be done in the meantime. There has been too much disjointed work in the production of cooking apparatus, and a co-operative effort by manufacturers and supply authorities is urgent. There are many matters of detail, but of great importance to success, which actual experience has demonstrated require consideration. American apparatus, although of light design and therefore not altogether suitable for British use, shows a better appreciation of the requirements necessary for satisfactory operation. The production of a suitable and reliable radiant heating unit in place of the usual hot-plate is a case in which the work of the committee should yield good results. It is highly probable that valuable assistance could be rendered by the National Physical Laboratory in solving certain problems connected with electric heating and cooking.

The Publicity Sub-Committee has been instructed to prepare a complete scheme for the development of a publicity organisation in this country. A first essential of success is the appointment of a thoroughly competent whole-time specialist in publicity, and at the same time a more liberal spirit of co-operation of the various interested parties is of equal importance. The hanging up of the I.M.E.A. Bill—which contains provision for enabling local authorities to subscribe to such an organisation—also continues to prevent progress.

The passing of the Summer Time Act serves to emphasise the courage and foresight of those undertakings which had adopted the Norwich or some other system of standing and running charges for domestic purposes before the use of metal filament lamps became general. Although the basis for arriving at the standing charges in these cases may possibly be considered open to criticism, still in practice they have been found fair and workable, and the advantage to the undertaking by the adoption of such a system, in maintaining financial stability against the large drop in revenue resulting from the introduction of more economical lamps and other causes, far outweighs any such objections. The loss of revenue resulting from this Act brings home the importance of the development of the use of electricity for other domestic purposes. Gas undertakings, through having developed the heating and cooking load, can regard the loss of revenue in this direction with less concern. My own experience in bringing before the householder the merits of electricity for domestic purposes has convinced me that there is a very large potential demand if only the electrical industry is ready with a supply of suitable apparatus, which can be obtained by consumers on terms comparable with those to which they have become accustomed.

Coal Supplies.—The question of sufficient supplies of coal for the maintenance of electricity undertakings has been a source of anxiety during the past year to the individual members of the Association, and promises next winter to become critical. The Council have done what is possible by appointing a Sub-Committee to watch the question and by supporting representations to Parliament and the Board of Trade. It should be realised that the Government are in a position of considerable difficulty in regard to this matter, and that although they have apparently not been able to give much material assistance to individual undertakings, at the same time there is reason to believe that in view of the many demands on them they have endeavoured to help as far as possible with due regard to other claims of equal importance. The proposal of the Board of Trade to urge consumers to make a percentage reduction in lighting with a view to economy in coal is not likely to have the desired effect. The provision of a large number of extra meter readers would greatly increase expenses, and the annoyance to consumers of frequent visits would cause unnecessary friction probably without affecting any appreciable economy. The view of many supply authorities that an increase in price is the more effective way of bringing about economy is undoubtedly correct.

British Engineering Standards Committee.—A tribute is paid to the valuable work of this Committee, and the hope is expressed that local authorities will help forward its work by subscribing.

Financial Control.—Experience has largely proved that the control of accounts by an official independent of the engineer-manager inevitably leads to unsatisfactory results. In very many cases a complete set of books in duplicate have to be kept so that the manager can properly watch over the working results. Nowadays the chief official of an electric supply department must, to an increasing extent, devote his energies to the financial and commercial side of the business; at the same time his training and experience enables him to guide the work of the technical staff. From the logical point of view of a ratepayer it would be much more satisfactory if the municipal accountant, apart from matter of loans at any rate, were to act as an internal auditor.

Constitution of the Council.—The constitution of the Council has in recent years been fully reviewed by the members, but some still urge that the Council should contain a definite minimum number of members representing small undertakings. This question is one for the decision of the members as a whole, but it should be borne in mind in considering this matter that the members elected to the Council should be those who, in the opinion of the majority, are likely to carry on the work to the greatest satisfaction of the Association, irrespective of whether such members represent large or small undertakings. The views of the various sections, however, should be represented on the Council. It has been further urged that with a view to enabling all members of the Association to participate in the election of officers and members of the Council, the present arrangement of voting should be changed to a postal ballot. Members will have an opportunity of deciding this point at the annual meeting.

British Trade after the War.—In the report of the Board of Trade Committee on British Trade after the War, it is proposed that local authorities amongst other public bodies should be under legal obligation to purchase as far as possible only goods produced in the British Empire. It is felt by the Council that discrimination between local authorities and private companies in this matter is unjust to the ratepayers, and that whatever restrictions are made with a view to assisting British manufacturers, should be equally applicable to all interests. The Council are hoping to have their views placed before the Electrical Trades Committee appointed by the Board of Trade.

Members will probably be interested in the clause in the recent act of the Tunbridge Wells Corporation authorising the purchase of machinery for the electricity undertaking out of surplus profits. This forms a precedent which may be of value at some future time.

It is a matter of considerable gratification to find that during the past year an association on similar lines to the I.M.E.A. has been formed in South Africa, and it is hoped that there will be close working and mutual assistance in the future between the two Associations.

It had been my intention during the past year to have placed before the Council some scheme whereby the members of the Association would be kept in closer touch with the various matters which the Council have had under consideration from time to time. This would, I feel, help to maintain and probably materially increase the interest of the members in the work of the Association which at the present time tends to be confined to the duration of the annual convention. I regret, however, that present conditions made it inopportune to bring forward this question.

In concluding these remarks I feel sure that I am echoing the feelings of all present when expressing the earnest hope that before the Association meets again the British Empire will have gone far towards attaining the objects for which the present prodigious sacrifice of its manhood and wealth is being made.

The Late Professor Silvanus P. Thompson.—At the meeting of the Institution of Electrical Engineers on Thursday to confirm the resolutions relating to enemy members, dealt with on another page of this issue, reference was made to the death of Professor Silvanus P. Thompson, and a resolution of condolence with his family was passed.

LAYING 20,000 VOLT CABLES ACROSS THE CLYDE

On Sunday, June 3, two 0·281 in. 3-core cables, for 20,000 volts pressure between phases, were laid across the Clyde at Whiteinch. They are for the purpose of connecting the portions of the Glasgow electricity supply system on the two sides of the river. The three conductors of the cable are of flattened sections, and are on the split-conductor system, so that each of the three is made up practically of a pair of concentric elipses with about one-eighth of an inch of dielectric separating them. The minimum radial thickness of dielectric between each of the outers of the "splits" and the lead is ⅜ in., the thickness of the lead is 0·66 in. and the lead is protected by two layers of galvanised steel armouring wires of 0·128 in. diameter. The overall diameter is about 4 in.

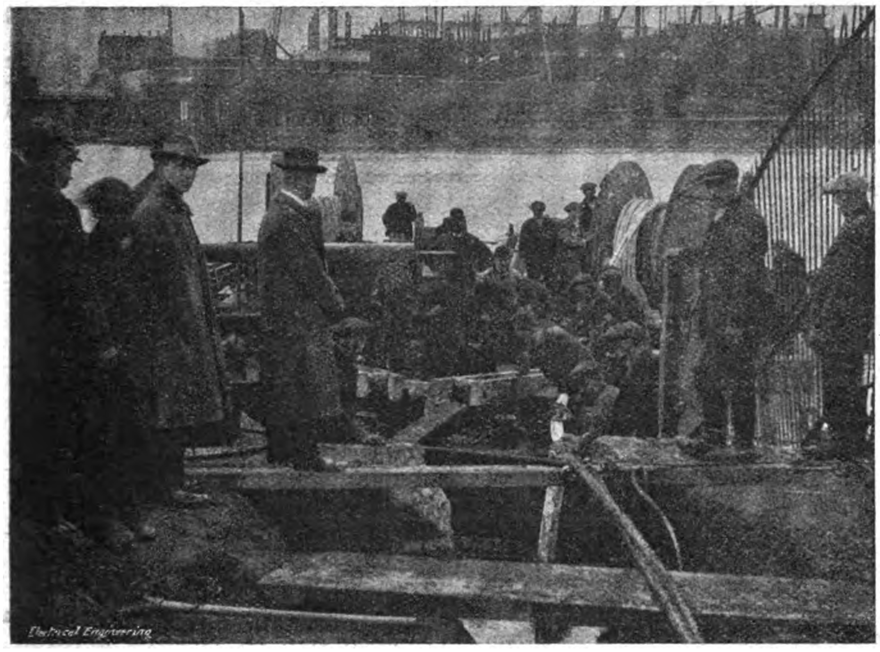

Fig. 1.—Ready to Start from the South Bank.

A distance of 130 yards separates the two banks of the Clyde at this point, and, with the additional length required at the two ends, the total length of cable required for each main was 200 yards. Each of these was in a continuous length and wound on a drum, weighing altogether about seven tons. In addition there was a 12-pair 1-18 lead-covered telephone cable on two other drums.

It had been stipulated by the Clyde Navigation Trust that the cable should be 30 ft. below water level, and a channel 12 ft. broad and 5 ft. deep was first dredged, the banks on either side opened, and a trench 3 ft. 6 in. deep dug there. The bank rises at an angle of 45° in places. Three flat-bottomed punts were borrowed from the Clyde Navigation Trust, and were bound together with beams, so that two were heading across the river and the other one at the stern of these at right angles to them, as seen in one of our illustrations. The main cables were paid off at the bow, and the drums were placed inclined slightly inwards, permitting the cable to be guided smoothly by a simple arrangement of woodwork to take the place of sheaves. A simple rope arrangement was provided to act as a brake in case the cable should "take charge" during the laying. Starting at the South side, a steel rope was fixed to the cables, passed under the punts, and hauled up the bank with a hand-winch. Then a rope was fastened to the punts, and they were hauled over to the North side by a steam-winch, while the cable was gradually paid off. Four kedge anchors were used to prevent the punt from slewing, but the cables were laid at low tide, and no trouble was experienced in this direction. The telephone cable was simply paid off at the stern. It took only ¾ hour to lay the cable from bank to bank, and traffic on the river was stopped only for an hour. The preparations for laying were started at 5 a.m. and the work was completed at 3 p.m.

On arrival at the North bank the 40 yards of cable left on each drum were paid out and laid in the trench by hand.

The only other alternative to laying the cable in the river was to make use of the Glasgow subway. This would have entailed a considerably greater length of cable and much street work in paved streets with tram lines to get to the nearest stations on each side, which would have been the only suitable points of entry. In addition, the length of cable would have been such that joints in the subway would have been essential, and the clearance in the subway would have hardly been sufficient for joint boxes.

We have to thank Mr. R. B. Mitchell, the mains superintendent, who was responsible for laying the cable, for giving us the necessary particulars and photographs for this article, and Mr. W. W. Lackie, the city electrical engineer, for permission to publish it.

South Africa's Resources.—According to the *Financial Times*, a highly important report has been issued by the Development of Resources Committee of the South African Institute of Electrical Engineers on the possibility of establishing there, on a commercial basis, certain electro-chemical industries. The report does not attempt to cover the whole subject, but is confined to South Africa's chief industries, agriculture and mining. These industries, taken together, now require annually more than two million pounds' worth of chemicals, all of which are imported in the form of fertilisers, cyanide, and nitrates. The essential elements for the successful manufacture of the compounds are cheap electricity, abundant coal, limestone, and the necessary labour. All these elements exist in South Africa, and furthermore the local market is to a considerable extent protected from competition by the necessarily high costs of transport chargeable on imported articles, as well as by Customs duty. The report considers separately certain compounds such as calcium carbide, cyanamide and derivatives of cyanamide, and comes to the conclusion that the various products mentioned can be profitably manufactured in South Africa provided the necessary raw materials are obtainable at reasonable costs. It is therefore urged that an early investigation with regard to the location, quality, and cost of production of these raw materials is a matter of the greatest possible importance, and it is hoped that the report will be the means of stimulating activity in this direction.

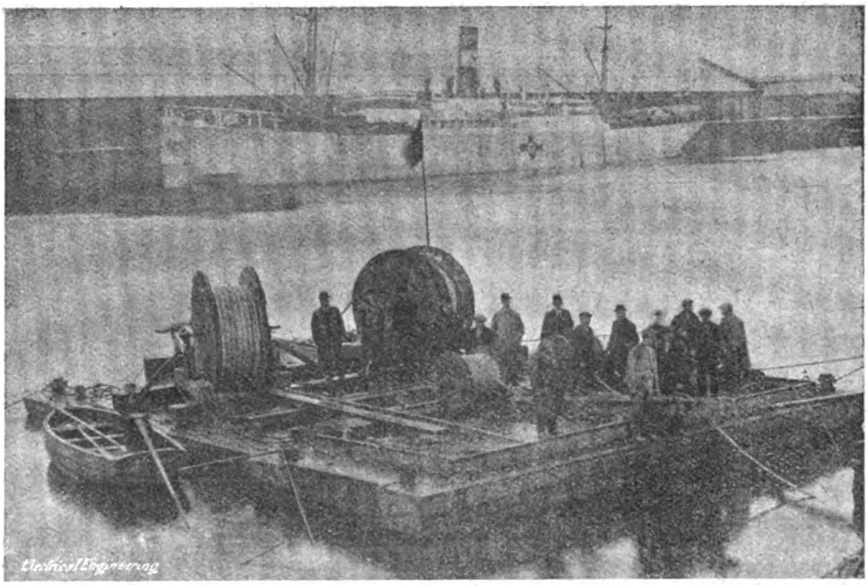

Fig. 2.—Bringing the Ends Ashore on the North Bank.

BOILER HOUSE DESIGN AND OPERATION*

By W. W. LACKIE (*Engineer and Manager, Glasgow Corporation Electricity Department*).

TWENTY years ago it was a simple matter to instal an additional boiler for each addition to the engine-room plant, as a reciprocating engine of 500 h.p., or even 1,000 h.p. with its generator occupied practically the same amount of space as the boiler plant required to supply steam to it. The area occupied by the boiler-house was practically the same as that for the engine-room, and extensions were easily made. The power per sq. ft. of floor space in the engine-room varied, but 1 h.p. was an average figure. The boiler-house was, as a rule, a one-storey building and an evaporation of 14 lb. of steam per sq. ft. of boiler-house space, or 42 lb. per sq. ft. of boiler floor space was considered a good average figure for steaming capacity.

A few years later, when larger stations were being erected, the power per sq. ft. of engine-room space was not seriously increased, as condensing engines were installed. Larger boilers were used, but economisers were added, as a rule, on the boiler-house floor level, and the evaporation per sq. ft. of boiler-house space was not seriously increased. Improved load factor, and the introduction of the steam turbine about 1904, brought a distinct change in the relative space required. The turbine-room came to consist of a two-storey building, with condensers on the ground or basement floor, and the turbo-generators above. We have to-day turbine rooms with 5 h.p. per sq. ft., and in designs for new power stations, using 15,000 to 30,000 kw. sets, this figure may go up to 20 h.p. per sq. ft. It is now recognised that where very large turbo-generators are in use, every pair requires a separate boiler-house. Several present-day power houses have an evaporation of 50 lb. of water from and at 212° F. per sq. ft. of ground space occupied by the boilers, but it is possible with improved design of the boiler-house plant to approach 100 lb. Thus instead of the boiler and engine-house floor space being about equal the ground space occupied by the boiler-house is now from 1½ to 2½ times that occupied by the turbine-room.

The first consideration is to ensure the maximum grate area per sq. ft. of boiler-house floor space, and it appears that burning coal with natural or induced draught at from 25 to 30 lb. per sq. ft. of grate area there is a limit to the maximum possible continuous output per sq. ft. of grate area, and that consequently there is a limit to the maximum power per sq. ft. of boiler-house floor space. It is in fact now recognised that a modern boiler-house should consist of three storeys at least: the basement or ground floor containing ash-handling plant; the second floor containing the boilers proper, and the third or upper floor containing economisers and coal conveying machinery and probably coal storage in the form of overhead hoppers above the boilers. Draught fans may be placed on any one of the three floors.

The question of chimneys and chimney draughts is by no means settled, but in stations where boilers of 50,000-lb. capacity are installed it is necessary to erect a separate chimney for each boiler or each pair of boilers. One is practically compelled to adopt steel in preference to brick, as with steel the chimney can be erected from the third floor, on which the economisers are placed. The brick chimney foundations and superstructure up to the second floor simply mean a waste of valuable space and a mass of brickwork which serve no useful purpose.

It is desirable not only to deal with ashes ejected from the boilers, but also to deal with riddlings and any semi-burned fuel. These riddlings have to be returned to the coal-conveying plant and thence to the overhead coal hoppers so as to be used again in the furnace.

The necessity for concentration of power has made the water-tube boiler indispensable for the modern power-house. The evaporative capacity of any boiler depends upon the grate area, or, in other words, the quantity of coal which can be burned underneath it, and consequently the maximum concentration of power is obtained when the whole of the generating and recuperating surface is assembled directly over the grate. Even with this type of plant the assembling of the heating surface over the grate area is undergoing modifications in order that the highest possible evaporation per sq. ft. of ground space may be obtained.

The space actually occupied by boilers at present with the necessary passages between, does not as a rule exceed 33 per cent. of the total boiler-house floor space, and of this 33 per cent. the grate area only accounts for one-half.

Let us consider the case of a boiler-house which has to supply steam to two 15,000 kw. sets. The steam required for each set will amount to between 180,000 and 200,000 lb. of superheated

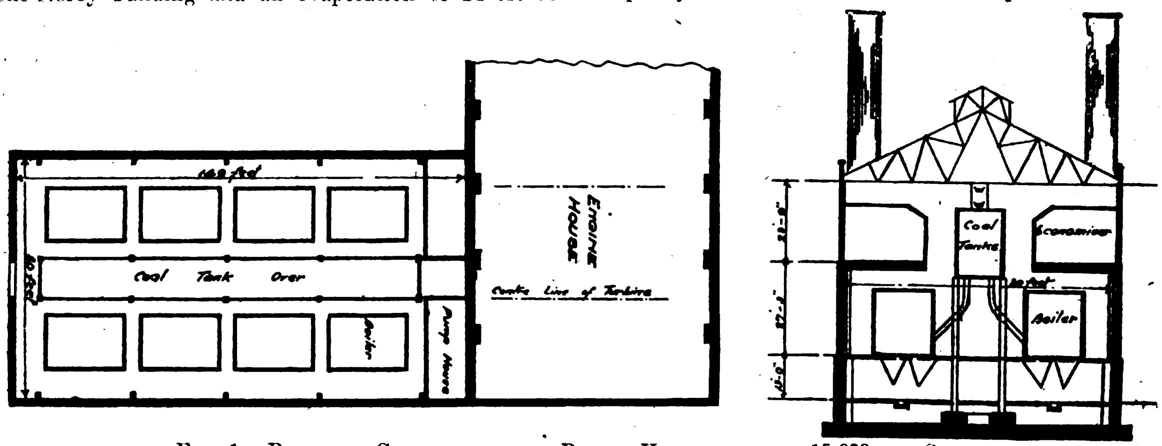

FIG. 1.—PLAN AND CROSS-SECTION OF BOILER HOUSE FOR TWO 15,000-KW. SETS.

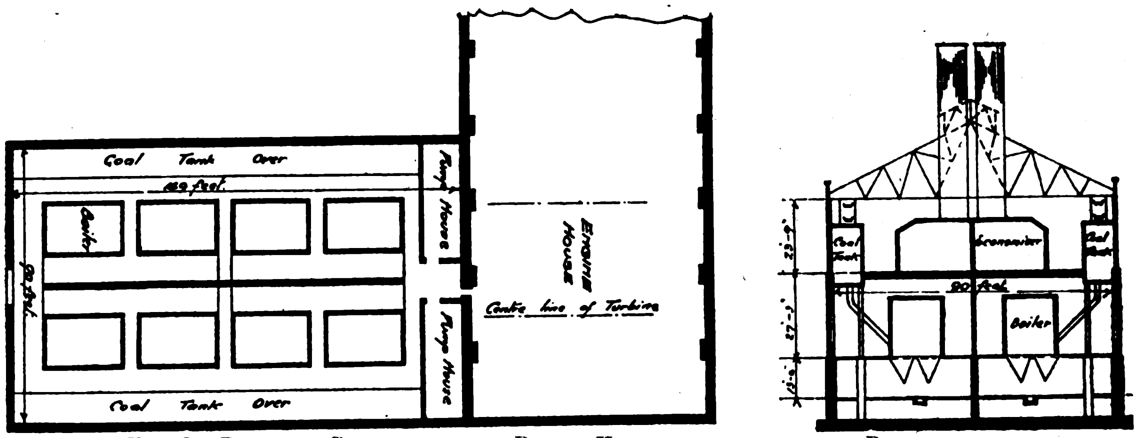

FIG. 2.—PLAN AND CROSS-SECTION OF BOILER HOUSE WITH BACK-TO-BACK BOILERS.

* Abstract of a Paper to be read before the I.M.E.A. to-day.

steam per hour. This steam under modern conditions would be supplied by four boilers, each capable of generating 50,000 lb. of steam per hour. Each boiler will require to burn at least 7,000 lb. of coal per hour depending upon the calorific value of the coal. This means that grates of 250 to 270 sq. ft. will be necessary. A grate area of 250 sq. ft. means that each boiler will actually occupy, with passages between, about 500 sq. ft., and the boiler-house will have a floor area of 12,000 sq. ft. Fig. 1 shows a plan and cross-section of such a boiler-house.

From what has been said it is clear that increasing the size of the boiler unit will not of itself seriously increase the power per sq. ft. of floor space. Twenty years ago water tube boilers of 4,000 to 6,000 sq. ft. heating surface were considered large. To-day boilers are made with a heating surface from 10,000 to 20,000 sq. ft. In Detroit five boilers each with over 20,000 sq. ft. heating surface are in use.

The plan of installing the boilers themselves on two floors ought only to be adopted where the exigencies of the site render such an arrangement inevitable.

The boiler-house should be designed to admit of an ample supply of natural daylight. This is managed by placing the boilers back to back, with a firing floor down each side. This, however, means a large floor area and a space between parallel boiler-houses. Such an arrangement is shown in plan and section in Fig. 2.

There is still a tendency to-day to construct the combustion chamber of boilers much too small. The author finds that the older boilers had 2 to 2½ c. ft. of combustion chamber per sq. ft. of grate area. To-day similar boilers have 5 c. ft. of combustion chamber per sq. ft. of grate area. The Detroit boilers before referred to have 9 c. ft. per sq. ft. of grate area, and it is generally conceded that this fact is very largely responsible for the high efficiency of these boilers at widely varying loads.

The equipment of a modern boiler should include two draught gauges. One of these should show the difference in pressure between the combustion chamber and the outlet from the boiler, *i.e.*, the difference in pressure across the boiler elements. This will be a measure of the flow of gases through the boiler and will indicate when a boiler requires cleaning. The second draught gauge should show the difference of pressure between the ash pit and the outlet of the boiler. This second gauge will always read higher than the first and the difference is obviously a measure of the draught through the fire. Steam flow meters are as necessary on boilers as an ammeter is on a generator, as they indicate whether all the boilers are doing their fair proportion of the work. One or more CO_2 recorders have been for some years installed as part of boiler-house equipment. A word of warning, however, is required against assuming that high CO_2 always means high efficiency. There may be a large quantity of CO present. There should be thermometers or pyrometers with dial face on each boiler, giving the temperature of the superheated steam leaving the boiler, also the temperature of the gases at the damper.

With boilers of the size under discussion, steam piping should be carried from each boiler or pair of boilers to a steam drum or receiver placed on the boiler-house floor or basement floor adjacent to the wall between the boiler-house and the turbine-room. This arrangement is preferable to one large steam header. From the steam receiver a steam pipe is led to a turbine and another pipe to the next receiver so as to give interchange of steam from one set of boilers to another when required.

Appended to the Paper are the results of a series of tests on steam-pipe and boiler-drum covering materials under like conditions. [The names of the materials are not given.]

We may at an early date see an increase in the boiler pressure from 160 and 200 lb. to 250 lb. The Commonwealth Edison Company of Chicago worked the boilers in their Fiske Street station at 200 lb. until 1907, when they adopted 225 lb. at their Quarry Street station, and in 1910 they adopted 250 lb. at their North-West station.

A station of 50,000 kw. capacity and burning 200,000 tons of coal per annum requires coal-handling facilities for a supply of 1,000 tons of coal per day, together with facilities for the handling of ashes to the extent of 100 tons per day. This means a railway siding capable of holding from 100 to 120 full trucks, and probably another siding of equal dimensions to hold the empty trucks. The length of railway sidings for a 50,000 kw. station would not be less than half a mile, or an addition to the site equivalent to 4,400 square yards. The wagons have to be tipped, and coal-conveying plant has to be provided capable of handling 100 tons per hour. Coal-breaking machinery should be installed, for circumstances may in the near future render it economical to buy and break larger coal. Large coal-storage accommodation is advisable and will prove economical. Not less than from two to four months' fuel supply should be retained.

(*To be concluded.*)

Enemy Firms Wound Up.—Under the Trading with the Enemy Amendment Act, 1916, further orders have been made by the Board of Trade for the winding up of Charles H. Blume, varnish and enamel manufacturer, Western Road, Mitcham, Surrey, and the Standard Cable Manufacturing Co., Ltd., agents for cable manufacturers, 18/19 Queen Hythe, E.C.

THE GENERATION OF ELECTRICITY ON A SMALL SCALE OR BULK SUPPLY*

By Harry S. Ellis (*Borough Electrical Engineer, South Shields*).

Some years ago the Newcastle-on-Tyne Electric Supply Co. tried very hard indeed to persuade the South Shields Corporation to take their supply from the Company, but the engineer at that time (the late Mr. J. H. Cawthra), assisted by Mr. (now Sir) John Snell, appeared to have satisfied not only his Committee and the Town Council, but also the Local Government Board, that by the time proper allowance was made to cover the interest and sinking fund charges on the Corporation's own plant already installed—*plus* the cost of converting the Company's E.H.T. three-phase A.C. supply to D.C. and single-phase—there would be no saving whatever. The Corporation proceeded with their extensions, and the results have been entirely satisfactory. Since that time the author has installed and set to work further modern electrical, and also steam generating plant, with the result that still further economies are being effected, and there is every indication that the undertaking will be in a position to cope satisfactorily with any business that is likely to come along in the future.

Coal alone accounts in many electricity works for about half, and in most cases for at least one-third, of the total working costs. It has often struck the author as strange that so much time and thought should be given by engineers to the question of saving ½ lb. of steam per kelvin, and yet practically nothing is done collectively to reduce the price of the coal delivered. As things are at present we are all more or less in the hands of the colliery owners or coal merchants. If Mr. Ferranti's dream of a national scheme for electric supply is ever to be realised, the colliery will have to be as much a part of the electric supply undertaking as are the generating station and the distribution system. In one case which has come to the knowledge of the author the average price of coal rose steadily until it reached a figure of 30 per cent. higher than that paid thirteen years previously, and even then the maximum price to date was not reached, because shortly afterwards the effects of the miners' strike caused prices to rise still further, and they have never been less than the figure referred to. What the effect of the present war will be it is impossible to tell. (See Fig. 1.) The steady all-round increase in the price of coal during the past ten or fifteen years has to a great extent, if not entirely, neutralised the effects due to increased efficiency of steam raising and electricity generating plant, and that the lower costs obtained have been due largely to the effect of the improved load factor on the other items which go to make up the total works costs.

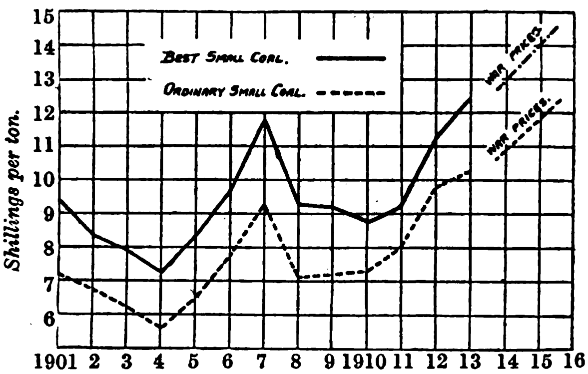

Fig. 1.—Curves showing Average Market Price of Welsh Steam Coal, F.O.B. Cardiff.

The figures were obtained from Mr. Stanley Jevon's book entitled "British Coal Trade," and confirm fairly well the Author's experience of coal prices in the North of England.

One of the chief reasons for the steady increase in the price of coal for electricity works is without doubt the wider market which is opening out for the use of small coal and "duff." The latter is now made up into briquettes, not only in this country but abroad, and also sold at moderately high prices for use in connection with mechanical stokers for steam-raising purposes. Many collieries have spent thousands of pounds on elaborate coal-washing plant for the purpose of cleaning this and the higher grades of small coal, such as peas and nuts, with the result that they are now

* Abstract of a Paper to be read at the I.M.E.A. meeting to-day.

in a position to sell "washed duff," as it is called, at prices very little below the prices of the better qualities.

In the case of the proximity of the generating station to a coal mine supplying screened coal for household purposes, small coal can be bought for an almost nominal sum per ton. It does not always follow, however, that the proximity of the generating station to the coal mine will result in low costs. The author's experience during the past four years in South Shields has been quite the reverse, for the simple reason that three local collieries within the borough, belonging to the same company, and shipping upwards of 2,000,000 tons of coal annually from staiths situated within a radius of a quarter of a mile of the electricity work, are unable, or at any rate unwilling, to supply even a small quantity like 10,000 tons per annum at a price less than that which electric supply engineers would consider a very high one. The reason for this is that the coal literally drops from the pit mouths into the vessels which take it away to other ports. It is evident, therefore, that Mr. Ferranti's idea about putting down a generating station at the pit mouth is of no use whatever unless the output of the pit is to be used primarily for the purpose of generating electricity or unless a contract be made for supplies over a very long period. The latter course is followed in the case of all waste heat power stations. In these cases the contract for waste heat to be supplied is probably much longer than the life of the plant installed in the generating station.

It is surprising to note how a Committee or a Board of Directors will discuss at length, and in minutest detail, the question of an increase in salary or wages which does not affect the fifth decimal figure in the total costs figure, and then ten minutes later accept an offer for coal which materially affects the first decimal figure without more than a few passing remarks.

The same type of boilers, economisers, and all the acces-

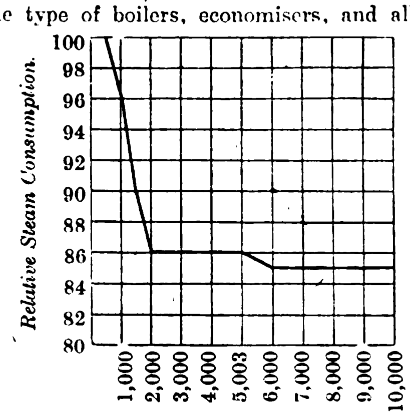

FIG. 2.—APPROXIMATE RATIOS OF STEAM CONSUMPTION OF VARIOUS SIZES OF TURBINES.

sories which go to the making of a modern boiler-house can be purchased and installed by a comparatively small undertaking as well as by the larger ones, and for equal load factors it is doubtful whether there is much difference in the relative efficiencies of the large and smaller plants—that is, provided the stand-by plant is proportionate in each case. But this is just where the larger station is likely to gain as the smaller station, working with, say, two boilers on load, will require a third (equal to 50 per cent. of the total) as stand-by; whereas, owing to the normal overload capacity of any boiler, the larger station, working with, say, ten boilers, can with safety run without any stand-by boiler at all.

Careful study of several evaporation tests carried out on a number of boilers of the water-tube type has satisfied the author that large boilers have very little (if any) advantage over smaller ones from the point of view of efficiency, whatever may be their advantages from the point of view of cost, floor space, &c. (There was practically no difference in the efficiency of boilers having 1,800 and 7,330 sq. ft. of heating surface respectively.) Under normal test conditions it would appear that 78 per cent. is an average efficiency for the boiler and superheater, with about 85 per cent. for the boiler, superheater, and economiser, although in one case the efficiency was recorded as being 87 per cent.

Fig. 2 shows very clearly the rapid relative decrease in steam consumption per kelvin of modern high-speed turbine plant from sizes of 500 kw. to 2,000 kw., and the remarkably slight fall between sizes of 2,000 kw. and 10,000 kw. It will be seen on referring to this figure that the larger sizes of plants have a gain over the smaller sizes of from 5 per cent. to 15 per cent. How long this condition of things will continue it is impossible to say, but from a careful study of results obtained with the "Brush Ljungström" it would appear that the difference in efficiency of large and small turbines is a factor which is slowly but surely diminishing. It is almost impossible to get the steam consumption, even of the very largest sets, much below 12 lb. per kelvin, which compares very favourably indeed with the average of 15·5 lb. per kelvin for the best known types of turbines of about 1,000 kw. output. A 1,000 kw. Brush Ljungström radial flow turbine, on the other hand, is capable of developing its full rated output with a steam consumption of only 12·75 lb. per kelvin under similar conditions of steam and vacuum.

One of the very largest and most efficient turbines which has ever been built appears to be the 25,000 kw. set supplied by Messrs. C. A. Parsons of Newcastle-upon-Tyne to the Chicago Edison Company (Fisk Street Station), which set has the remarkably low steam consumption of 11·65 lb. per kelvin at full load when supplied with steam at 200 lb. per square inch, 200 degrees superheat (Fahr.), and with a vacuum of 29 inches. Another very efficient set is one of 6,250 kw. installed at the Dunston Power Station of the Newcastle Electric Supply Company in which case the steam consumption on test was but slightly more than in the case cited above.

The largest Brush Ljungström machine is now being erected at Willesden for the North Metropolitan Electric Supply Company—its normal rating being 7,000 kw. at 3,000 r.p.m. and its overload capacity 10,000 kw.

(To be continued.)

Arrangements for the Week.—(To-day) *Thursday, June 22nd:* Incorporated Municipal Electrical Association. Annual meeting at Institution of Electrical Engineers, Victoria Embankment. 10 a.m. Presidential address by Mr. A. C. Cramb, Borough Electrical Engineer, Croydon; and Paper on "Boiler House Design," by W. W. Lackie, Chief Electrical Engineer, Glasgow. At 2.30 p.m. the following Papers will be read:—(1) "Area of supply from an economical standpoint," by H. S. Ellis, Borough Electrical Engineer, South Shields; and (2) "The Application of Electric Power to Agriculture," by W. T. Kerr, City Electrical Engineer, Hereford.

Friday, June 23rd: Incorporated Municipal Electrical Association. Annual business meeting at Institution of Electrical Engineers, Victoria Embankment. 10.30 a.m.

Tuesday, June 27th: Association of Supervising Electricians. Annual General Meeting at St. Bride's Institute, Bride's Lane, Ludgate Circus, E.C. 7.30 p.m.

THE INSTITUTION AND ITS ENEMY MEMBERS

The final meeting to confirm the resolutions already passed dealing with enemy members of the Institution of Electrical Engineers was held on Thursday. The President, Mr. C. P. Sparks, was in the chair, and the proceedings lasted less than ten minutes. The proposal for the confirmation of the resolutions was put by the President, the resolutions reading as follows:—

(*a*) To expel members who are subjects of enemy countries or States.

(*b*) To expel members who, being naturalised British subjects, have retained enemy nationality.

(*c*) *Not* to expel members who are naturalised British subjects and were formerly subjects of a country or State now at war with Great Britain and Ireland, but who have under the laws of such country or State definitely lost their alien nationality, provided they are able to prove this to the complete satisfaction of the Council.

(*d*) That no person shall after the . . . day of . . . , 19 . . , be eligible for election as a member of the Institution who is a subject of any country or State with which the United Kingdom of Great Britain and Ireland is or shall have been at war on or after the date mentioned.

Mr. L. B. Atkinson formally seconded the adoption of the resolutions, and the proposal was carried without discussion, one member dissenting. Mr. Atkinson added that he would not like the meeting to close without a word from himself as one of the members who sent the request to the Council to deal with this matter. At that time there were a considerable number of members who were somewhat dissatisfied that the Council had not taken some action in the matter, but everybody now knew that the Council could not move without a request from the members to do so. He would like to propose a hearty vote of thanks to the President for his action in the matter, for as soon as the members met him and explained the position he immediately took the initiative in the action, which led to the holding of the meetings, and from that time onward very little difficulty had been experienced.

The President expressed his appreciation of the vote of thanks, and pointed to the way in which everybody had worked together for a common end, with the result that he believed a very difficult matter had been carried diplomatically. He hoped the result would be effective, but that if it were not the members had only to approach the Council again and he was quite sure the Council would not be found hostile. At any rate, whilst he was President he would do all in his power to assist Mr. Atkinson or any other members to forward the true interests of the Institution.

ELECTRIC TRACTION NOTES

A considerable use of women labour is being made in the tramways department of the Glasgow Corporation, not only as drivers and conductors, but as assistants in the power station. Several months ago four women were employed to assist the electrical engineer in the power station, and they are now in full charge of a sub-station, while four others are at work on the power station switchboard. This has enabled the department to let off an equal number of men to join the colours. The day is divided into three eight-hour shifts, as in the case of men sub-station assistants. Women are also being employed for cleaning the electrical switch-pillars in the streets. The Glasgow tramways department in addition employs about 100 women as drivers, and they have been found to be very keen and enthusiastic, standing up to the work after a very short time as coolly and confidently as the most experienced motor-men. Mr. Dalrymple, the general manager, tells us that the women drivers are freer from accidents than the men, as they stick more rigidly to the rules and do not try any dodges of their own. At present it is impossible to say whether the employment of women has affected the current consumption and repairs, but the general impression is that women are, if anything, more careful in their driving than the men.

With the electrification of the Hampton Court line the whole of the first section of the London and South-Western Railway Co.'s electrification scheme will have been completed, with the exception of a short portion between Surbiton and Claygate.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published June 15th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

22,807/15. **Wireless Remote Control.** M. Compare. A system of controlling any series of operations from a distance involving the use of several oscillators so arranged that the radiant energy can effect only one of such oscillators at a time, and when one has attained a predetermined amplitude of vibration, this will cause another to be set in motion, and so on, and the last of the oscillators, upon attaining its predetermined amplitude of vibration, will then cause the desired operation to be effected. (Three figures.)

717/15. **Feeder Protection.** J. H. Bowden and H. F. J. Thompson. A system for protecting cables, having a conducting shield surrounding each conductor to protect it against leakage between conductors, and having also an insulating conducting shield surrounding the whole for protection against external damage. Earthing of the outer shield by external damage places a high voltage upon the conductor shields, which operates mechanism disconnecting the faulty section of the cable. (Two figures.)

2,897/15. **Electric Traction.** F. G. Brettell (*J. Leffler*). A system of continuous railway traction with track magnets spaced apart and connected with the supply so as to afford a magnetic field extending along the line of travel. Under the car is a non-rotating armature with a separate rotating commutator for co-operating with the track magnets. The track is divided into insulating sections, comprising a third rail for supplying both the fixed field magnets and the travelling, with automatic devices at the end of each section for controlling the supply of current as the car passes over. (Twenty-four figures.)

7,829/15. **Metal Filaments.** K. Nishimoto. A mixture of finely powdered tungsten and thorium is consolidated into sticks by pressure, sintered electrically, allowed to cool slowly, and, while at a dull red heat, hammered and rolled.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: A. E. Tanner and E. A. Claremont [Cable joints] 4,109/16 (*100,511*); MacFarland and Shoemaker [Insulating material] 8,004/15.

Dynamos, Motors and Transformers: Maschinenfabrik Oerlikon [Stator casings] 8,417/15; B. T.-H. Co. [A.C. motors] 11,473/15.

Electrometallurgy and Electrochemistry: Walker [Electrolytic separation of metals] 8,305/15; Hunt and Gidden [Electrolysis of sulphate liquors] 14,273/15.

Heating and Cooking: Cheshire [Heating elements] 12,702/15; Clemens [Electric soldering wires] 16,452/15.

Ignition: Thomas Crosbee & Sons, Ltd., and Spicer [Sparking plugs] 4,808/15.

Instruments and Meters: Chinn and Butler [Cases for ammeters and voltmeters] 9,408/15.

Switchgear, Fuses, and Fittings: Wooliscroft [Resistance regulators] 6,340/15; Berry [Protective gear] 8,106/15; Goss Printing Press Co. [Controllers for printing-press motors] 11,684/15; Wynne [Switches] 12,772/15; Collinson [Resistances] 14,164/15; Markt [Switches] 15,563/15; R. W. McLachlen [Shade carriers] 801/16 (*100,525*).

Telephony and Telegraphy: Yates, Gambling, and Parker [Guards for telephone cords] 14,499/15; Signal Ges. [Multiple contact microphones] 3,533/15 (*100,156*).

Traction: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Control of electric automobiles] 6,197/15; Bethenod [Vehicle lighting] 11,224/15.

Miscellaneous: Westwood [Cases for cycle lamps] 7,909/15; H. R. van Deventer [Condensers] 955/16 (*100,081*); Waygood-Otis, Ltd. (*Otis Elevator Co.*) [A.C. electromagnets] 3,389/16 (*100,519*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Telephony: Western Electric Co. [Call distributing telephone systems] 7,258/16 (*100,535*).

Miscellaneous: Siemens-Schuckertwerke Ges. [Connecters] 6,977/16; E. W. Jefferson [Terminal seal for batteries] 6,982/16 (*100,534*).

Application for Admendment

22,549/14. **Intercommunication Telephones.** C. B. Kersting. Amendment is sought in the wording of the claims in order to "limit definitely the ambit of the claims." The specification describes a system employing automatic selector switches.

Opposition to Grant of Patent

580/15. **Telephony.** Betulander Automatic Telephone Co. (now Relay Automatic Telephone Co.) and W. Aitken. The grant of a patent on this application has been allowed in spite of opposition. The specification deals with a junction line working. When connection is made to the outgoing end of a junction line, a signal is displayed at the incoming end and a "B" operator's telephone is automatically connected thereto. Means are provided for displaying as many signals as there are lines calling and for preventing more than one line being connected at one time with the "B" operator's telephone.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

14,373/02. **Battery Boosters.** Lancashire Dynamo & Motor Co., Ltd., and R. S. McLeod. Automatic reversible boosters for the control of buffer batteries to equalise the load on the generating plant.

14,228/02. **Magnetic Clutches.** W. Schuster. Magnetic clutches with an air gap and friction surfaces of non-magnetic material.

14,286/02. **Electric Traction.** T. A. Hearson (*F. J. Sprague* and *E. R. Carichoff*). This patent covers a number of details in an improved multiple unit train control system employing interlocked electromagnetic contactors.

14,430/02. **Printing Telegraphs.** F. H. W. Higgins. A rotating type-wheel column-printing instrument.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: Siemens Brothers & Co., Ltd. (*Siemens & Halske*) [Ventilated double commutators] 4,836/03; Crompton & Co., J. C. Macfarlane, and C. Burge [Control of variable-speed motors] 5,168 and 21,113/09.

Telegraphy and Telephony: M. S. Conner [Relays] 5,145/09.

Miscellaneous: J. H. Marshall and W. H. Smith [Electric pianos] 4,710/08.

State vers. Company Electricity Supply in Switzerland.—Our Swiss correspondent writes that considerable discussion has been aroused in political circles in connection with the purchase of the Wangen Electricity Works Co. by the Bernese Power Co., a powerful concern supplying nearly four hundred separate localities with electric power. [The sales of the Bernese Co. in 1915 amounted to 78 million units, including current for electrochemical and railway purposes, and the net profit of 1,083,000 francs enabled the payment of a dividend of 5½ per cent. for 1915, as compared with 5 per cent. for 1914.] The feeling against the company became so strong in socialistic circles that the question was raised in the Berne Cantonal Council as to whether this recent development of the company was in the public interest, or whether the Government should not study the question of State electricity supply in the Canton and the advisability of purchasing the Bernese undertaking. In the debate, however, it was stated that about 94 per cent. of the shares of the company are now held by the State or the Cantonal Bank, and that the representation of State authorities on the board of the company is ample to protect the public interests. The suggestion for the conversion of the undertaking into a State Department was therefore talked out, the fact being emphasised that in its present form the undertaking had many privileges and advantages which enabled a free play for initiative and extensive business, and which would not be inherent to a State Department.

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

QUESTION No. 1,499.

I have a 3-wire D.C. distributor main, 1,000 yards long, to lay in a residential road with a few shops scattered along same. The maximum total load will be 44 kw., and this will be tapped off in fairly equal amounts along the distributor, so that the *average* load in the distributor will be 22 kw. The consumers' declared voltage is 220 volts, *i.e.*, 440 volts across the outers. I can allow 8 per cent. maximum drop in the main, so that if the total load were well balanced between the outers and the middle wire, a 0·075×0·075×0·035 sq. in. 3-core cable would do.

What increase on this theoretical size of cable should be allowed on account of out-of-balance in the load, and what out-of-balance is likely to occur on such a distributor?—A. M. J.

(*Replies must be received not later than first post, Thursday, June 29th.*)

ANSWERS TO No. 1,497.

In a power station here we have a d.c. motor-generator running as a balancing set on a three-wire system. The field coils of the two machines, although of fine wire, do not appear to be shunt connected, and there is no separate excitation. What is likely to be the method of field connection, and how is the voltage of the system regulated by these machines? Also, how is the size of a balancing set determined?—R. R.

The first award (10s.) is made to "W. I." for the following reply:—

From "R. R.'s" remarks it is almost certain the balancer set is shunt-wound; further, the shunts not being separately excited—which is taken to mean not connected across the outers of the three-wire system—or connected in the usual manner for a shunt generator or motor, seems to show that they are cross-connected as per Fig. 1. The operation of the set can best be explained by taking an actual case dealing with an out-of-balance current in mid-wire of 100 amps. and voltage across outers of 440. Both machines will be exactly similar electrically, and primarily adjusted so that with no-load on system the voltages between positive and neutral and negative and neutral are 220; under these conditions

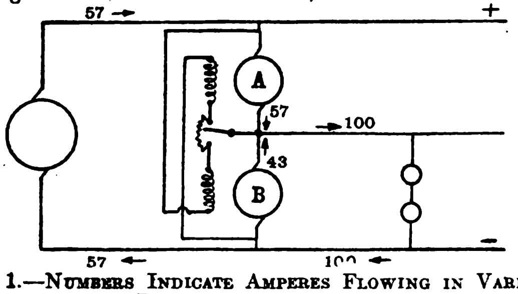

FIG. 1.—NUMBERS INDICATE AMPERES FLOWING IN VARIOUS PARTS OF THE CIRCUIT.

both machines will motor, taking current from the supply corresponding to no-load losses.

Now, if the maximum out of balance of 100 amps. comes on the negative side, the voltage on that side will drop and proportionately increase on the positive side, thus causing *B* machine to generate and supply part of the out-of-balance current, and *A* machine to motor; further, the field of *A* machine, being connected to negative side, will be weakened, thereby increasing the speed of the set; and the field of *B* machine, being connected to positive side, will be strengthened. The result of these two effects is that the voltage across *B* machine and negative side is increased, otherwise, this side being heavier loaded, the voltage will be less than across positive side. For the example taken, the voltage across the negative side would be about 217 volts, and across positive side 223 volts, giving a 3 per cent. regulation at full load, which is about the usual figure for this type of machine. Conversely, if the out-of-balance comes on positive side, machine *A* will act as generator and *B* as motor, also, if the load on each side is equal, the voltage on each side will be equal, and the balancer set will run light.

Neglecting efficiency, the current of 100 amps. would be split up equally between the two machines—*i.e.*, 50 amps. through machine *A*, driving it as motor, and the remaining 50 amps. generated by *B*. Now, introducing the effect of the efficiency, which may be taken as 87 per cent. for each machine, the actual current through motor *A* will be about 57 amps., and the current supplied by generator *B* 43 amps. The 57 amps. will be supplied by main generator as indicated in Fig 1. Balancer sets are usually designed to deal with an out-of-balance in mid-wire of 20 per cent. to 25 per cent. of the total line current. For the design of the individual machines it will be seen from above example that each must be capable of giving as generator an output slightly larger than half the out-of-balance current at voltage corresponding to half that between the outers.

The second award (5s.) is given to W. H." for the following:—

The connections of the balancer are evidently what is known as cross-connected shunt-fields—*i.e.*, the field winding of machine B_1 is connected across the armature of B_2 (see Fig. 2), while the field of machine B_2 is connected across armature of B_1. A centre connected rheostat is usually used to regulate the fields, although separate field rheostats may be used, or even none at all. The voltage is automatically regulated as follows: The balancer set is run up as two motors in series. The speed of each motor is such that the back E.M.F. of the armature is equal to half the live voltage. Thus the lead connecting the two armatures is at the same potential as the neutral wire on balanced load. In practice they are connected.

Now assume that the load between *X* and *Y* is greater than that between *Y* and *Z*. The tendency would be for the voltage across *X*–*Y* to fall, while a corresponding rise would tend to take place across *Y*–*Z*. This would tend to increase the speed

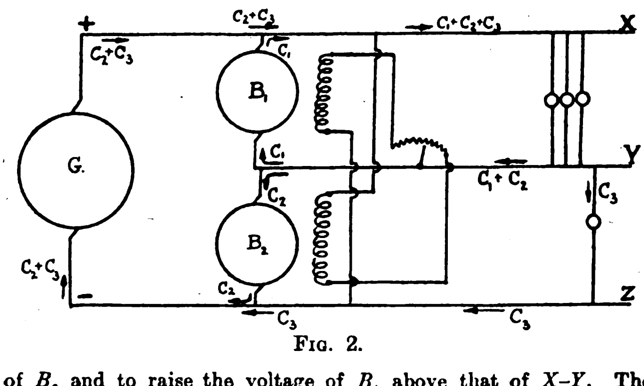

FIG. 2.

of B_2 and to raise the voltage of B_1 above that of *X*–*Y*. The net result is that B_1 acts as a generator and supplies a portion, C_1, of the out-of-balance current, while the power required to drive this generator is obtained from B_2 acting as a motor, the current driving this motor being the remainder, C_2, of the out-of-balance current. It follows, therefore, that any tendency for the voltage across *X*–*Y* to fall, due to out-of-balance current, is immediately counteracted by the balancer acting as a motor-generator with the generator supplying current to the heavier-loaded side of the system. It is obvious that some change in voltage must take place before the conditions outlined above can act, but this change in voltage is very small.

Compound winding is sometimes used to improve the regulation, but is, under certain conditions, liable to cause the sets to run away. The best way of illustrating the method of determining the size of a balancer will be to take an actual example. Assume voltage across outers, $V_1=500$ volts; voltage from outer to neutral, $v_1=250$ volts; out-of-balance current, $A_1=100$ amps., and assume the efficiency of each unit of the balancer set to be 90 per cent. at full load. (The field loss may be neglected, as the exciting current is supplied by the main generator.) Then overall efficiency = 81 per cent. The out-of-balance current *A* is, as shown, made up of the motor current C_2, *plus* the generator current C_1, and as each machine has practically the same terminal voltage, the ratio $C_1/C_2=0{\cdot}81$. Therefore $C_1=44{\cdot}7$ amps., and $C_2=55{\cdot}3$ amps. Either machine may be called upon to carry 55·3 amps. continuously, or generate 250 volts continuously. Thus each unit will be designed as a generator having a capacity of 55·3 amps. and 250 volts at any suitable speed.

LOCAL NOTES

Bedford: *Mains Extensions.*—The Town Clerk has been in correspondence with the Local Government Board on the question of mains extensions for other than war purposes, which the Board have prohibited. The Clerk put the question as to whether people in the statutory area had not a legal right to demand a service. The Local Government Board's reply is to the effect that the Board will not sanction a loan for any extensions except such as are necessary for war purposes. It appears that a certain amount of non-war work has been carried out, and the question of whether the cost shall be charged to revenue is to be determined by the Electric Supply Committee.

Oldham: *Electricity Accounts.*—The most notable feature of the accounts of the Electricity Department for the year 1915–16 is an increase of 2½ million units in the number of units sold, the figures for the past two years being 7,985,859 and 10,487,235 respectively. This increase, however, is much less than was anticipated, as owing to cotton mills under contract with the Department being unable to obtain the necessary plant the output is less by from three to four million units than would otherwise have been the case. The net profit was £5,107, against £3,550.

Sheffield: *The Reserve Fund and Mains Extensions.*—A proposal of the Electric Supply Committee to take £10,000 from the reserve fund for mains extensions was withdrawn at the last meeting of the Corporation after some discussion. Councillor Bailey, who moved the rejection of the recommendation, took the occasion to allege that the whole financial management of the Electric Supply Department is such that the Committee is bringing it to a state of bankruptcy. He said that whilst before the war current was being sold at a price which it was very debatable would cover the cost of production, there had been no increase since the war, notwithstanding the very high extra costs of coal, materials, &c. The Gas Company had increased their prices by 40 per cent., and the Electric Supply Committee ought to have put theirs up by at least 30 per cent. Alderman Styring reminded the Council, however, of the exceptional position in which Sheffield is placed, namely, that it is in competition with a gas company which supplies at the second lowest price in the country, and that, moreover, if the Sheffield steel industry is to progress as it ought to, the Department must supply on extremely economical terms. He alleged that Councillor Bailey would not have said a quarter of what he had if he had been in possession of the facts. Notwithstanding the allegations of bankruptcy, it would be found that when the accounts of the Department for last year were made up there would be a very substantial profit. It having been discovered that the Council is prevented by its Parliamentary powers from using the reserve fund for the purpose in question, the proposal was withdrawn.

Sunderland: *Increasing Demand for Power.*—In connection with the net profit of £1,031 mentioned in our issue last week, it was pointed out at the last Council meeting that this compares with between £3,000 and £4,000 during the past two or three years, and is notwithstanding a record sale of current. This, however, is due to a breakdown in connection with the large turbo-generator, which lasted for 33 weeks, and Mr. Blackman estimates the loss entailed at something like £3,509. At present there are more power consumers than at any other time in the history of the undertaking.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Aberdeen.—Tenders are to be invited for new generating plant.

Greenock.—The Secretary for Scotland has sanctioned the borrowing of £45,000 in connection with extensions at the power station. The terms are that the sum is to be repaid over 25 years, and that the surplus revenue of the undertaking, after meeting working expenses; depreciation, and capital charges, is to be transferred annually to the reserve fund until this has reached the maximum laid down by the Electric Lighting Acts.

Wolverhampton.—An application is to be made for sanction to a loan of £34,240 of new plant.

Miscellaneous

Exeter.—Twelve months' supply of electrical accessories for the County Lunatic Asylum. E. Harbottle, County Chambers, Queen Street.

Liverpool.—The Toxteth Park Guardians require three months' supply of electrical sundries. Clerk, 15 High Park Street. June 26th.

Sydney.—The Deputy Postmaster-General requires telephone switchboard material, &c. An automatic telephone switchboard is required for the City North Exchange, Sydney. Further particulars at 72 Victoria Street, S.W. Specifications, &c., may be consulted at 73 Basinghall Street. This information is only of use to firms who can cable agents, as the dates for receiving tenders are June 29th and August 17th respectively.

APPOINTMENTS AND PERSONAL NOTES

A proposal by the Sheffield Electric Supply Committee to pay Mr. S. E. Fedden, the manager of the electric supply department, a bonus of £100 in respect of extra work was opposed by the Establishment Committee of the Corporation at the last meeting, and eventually rejected. At the same time the discussion gave an excellent idea of the extra work which the electric supply department has done during the war, and a comparison was drawn between the salary paid Mr. Fedden, namely, £900, and that paid to the chief engineers in other large towns such as Birmingham (£1,400), Liverpool (£1,500), Manchester (£1,500), Nottingham (£1,350), and Salford £1,000).

The Gillingham Electricity Committee's action in releasing for military service Mr. Ritson, the assistant engineer, was the cause of some comment at the last meeting of the Council. It was stated, however, that Mr. Ritson was released at his own request after very careful consideration by the committee of the position at the power station.

It is with much regret that we hear that the only son of Mr. R. A. Chattock, City Electrical Engineer at Birmingham, was killed in action near Arras on June 4th. Private C. A. Chattock, who was only twenty-three years of age, after leaving Rugby and Charterhouse, studied at the Birmingham Municipal School of Art and in Paris. He was engaged on designing work when war broke out, and joined the 2nd City of Birmingham Battalion in October, 1914. This was afterwards named the 15th Service Battalion Royal Warwickshire Regiment, and with it Private Chattock went to France in November, 1915.

Mr. F. Dudley Docker, Chairman of the Metropolitan Carriage Wagon & Finance Co., Ltd., has joined the Committee of the Council for the Organisation of British Engineering Industry.

The War Department, Southern Command, requires a mains engineer, fitter, drivers, and engine-drivers, and wiremen. (See advertisement.)

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £135 to £137 (last week, £140 to £142).

ANNOUNCEMENTS RELATING TO PATENTS.

The Proprietors of the Patents Nos. 15,951 of 1913, 10,868 of 1914, for "Improvements in SAFETY DEVICES FOR ELECTRIC CONDUCTORS" and "Improvements in and relating to ELECTRICAL CONDENSERS and the Process of Manufacture thereof" are desirous of entering into arrangements by way of license and otherwise on reasonable terms for the purpose of exploiting the same and ensuring their full development and practical working in this country.—All communications should be addressed in the first instance to HASELTINE, LAKE AND Co., Chartered Patent Agents, 28 Southampton Buildings, Chancery Lane, London, W.C.

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SUMMARY

The reduction in output and the consequent decrease in revenue of supply undertakings, due to the passing of the Summer Time Act, has been the subject of an inquiry, and it appears that as a general rule the reduction is inappreciable in the case of industrial centres, but sometimes considerable in the case of residential areas. The difference is more marked in the southern and midland counties than in more northerly latitudes. Some typical load curves are reproduced showing the actual reduction in load after the passing of the Act (p. 237).

We conclude our report of the Annual Meeting of the I.M.E.A. There was an important discussion on Mr. Lackie's paper on "Boiler-House Design," not the least interesting feature of which was the information as to the experiments which are being carried out with gas firing of boilers at Glasgow, and a commercial scheme which the Brighton Electricity Department has made arrangements with the British Coalite Company to develop. Many central station engineers have a strong leaning towards co-operation between gas and electrical interests on this question, but there is also a body of opinion to the contrary (p. 239).

The discussion on Mr. Ellis's paper on the "Generation of Electricity on a Small Scale" served to crystallise ideas somewhat on the question as to whether linking-up should be put in hand before developing the so-called "super" electric power stations for the purpose of the distribution of electrical energy on a large scale. The work that has been done in London and that which is now being put in hand in Lancashire and Cheshire demonstrates that the first steps should be a linking-up of existing undertakings in specified areas with, as was pointed out in the discussion, subsequent linking-up of these particular areas, thus leading on to the time when the "super" power stations could be worked into the general scheme with success. Although linking-up met with the approval of most of those who spoke in the discussion, nevertheless there was the feeling that the "super" power-house should be the ultimate end (p. 242).

The final paper by Mr. Kerr on the "Application of Electricity to Agriculture" dealt with a subject not yet discussed to any great extent in this country, and a large amount of interesting information was forthcoming in the discussion. Councillor Dymond, of Hereford, raised the point as to whether agriculturists should be supplied at the usual rates, having regard to the figures which he gave of enormously increased profits. He urged that the cost of the current should bear some relation to the value of the use to which it was put (p. 245).

The business meeting on Friday, June 23rd, provoked the usual discussion on a variety of topics. Although the Council recommended approval being given to the Model General Conditions of Contract issued by the Institution of Electrical Engineers, a resolution to this effect had to be withdrawn on account of the opposition to it. Mention was also made of a threat by a gas company to take action against the Hackney Borough Council for alleged undue preference on the ground that it is charging power users a lower price for lighting than the ordinary lighting consumers (p. 249).

The contributor of the article on excess profits tax replies to the criticisms of his views (p. 251).

Among the subjects of specifications published last Thursday at the Patent Office were insulating material, protective apparatus, and A.C. motors. Patents dealing with magneto ignition, planing machine drive, D.C. motors, and electric automobiles (p. 252).

Our "Questions and Answers" page this week deals with the question of the disturbances produced in an A.C. transmission line on the breaking of an insulator (p. 252).

The new Oerlikon three-phase plant at Marylebone has more than fulfilled expectations. A number of municipal supply undertakings show wonderfully good costs figures notwithstanding increased cost of materials (p. 254).

(For orders for the week, 1st London Engineer Volunteers, see p. 251.)

DAYLIGHT SAVING ACT

Effect on Electricity Supply Undertakings

Considerable discussion has been taking place recently on the action of certain supply undertakings in increasing the charges for electricity since the passing of the Summer Time Act. This action has been strenuously opposed on the ground that the decrease in output consequent on the passing of the Act is not sufficient to warrant an increased charge, and, on the other hand, that the benefits of the Act, which were intended for the public and the nation at large, are being appropriated by the supply authorities. We have taken the opportunity of inquiring into this matter in some detail, and we have been able to inspect diagrams showing the actual modification caused by daylight saving in the load curves of a few leading supply undertakings in various parts of the country. These modifications, we find, vary very considerably, as one would expect. In Scotland and the northern counties the variations in load are naturally very small, as the day is comparatively long in these latitudes, and the saving effected by the Act correspondingly small. In Glasgow, for instance, the effect on the load curve is practically inappreciable, as it is also in Dundee, Aberdeen, Carlisle, and Sunderland.

Many causes other than latitude, however, appear to have a disturbing effect on these load curves. The general reduction of lighting effected soon after the outbreak of war makes the saving appear less than it would in normal times. Fig. 1 shows a typical example of this. Here the curves are given for May 22nd, 1916, and the corresponding times in 1915, 1914, and 1913. The area between the curves for this year and last represents, of course, the approximate reduction of output due to the Act, but under abnormal conditions of lighting, whilst the area between the 1916 and 1914 curves no doubt gives an exaggerated estimate of the saving; the actual reduction of load in normal times would probably be represented very roughly by the mean of these two areas, and in this case, as will be seen, it is by no means inconsiderable. Figs. 2, 3, and 4 represent the load curves of Belfast, Dublin, and Swansea respectively. All these show a distinct diminution of the output for lighting, but in the

case of the last two it is questionable whether this does not actually tend to economy, since it reduces the peak due to the evening lighting load, which appears to be the maximum load of the day. No such economy is effected, however, in

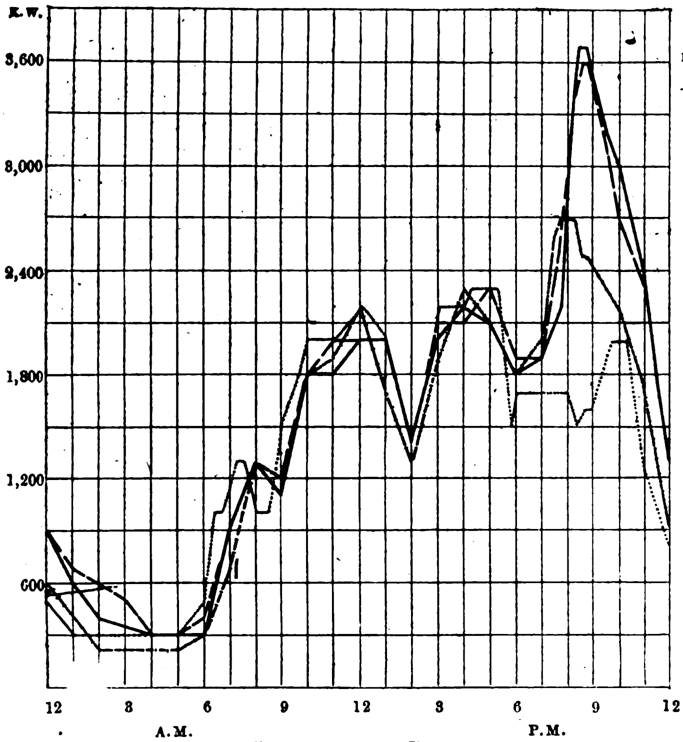


FIG. 1.—LOAD CURVES—BRIGHTON.

(The full line shows the load during May 22nd, 1913, the broken line for 1914, the dot-and-dash line for 1915, and the dotted line for 1916.)

such cases as are represented by Fig. 2, where the evening load is already less than the morning and afternoon power loads. This tendency to economy by the reduction of the maximum peak may, however, be offset to some extent by

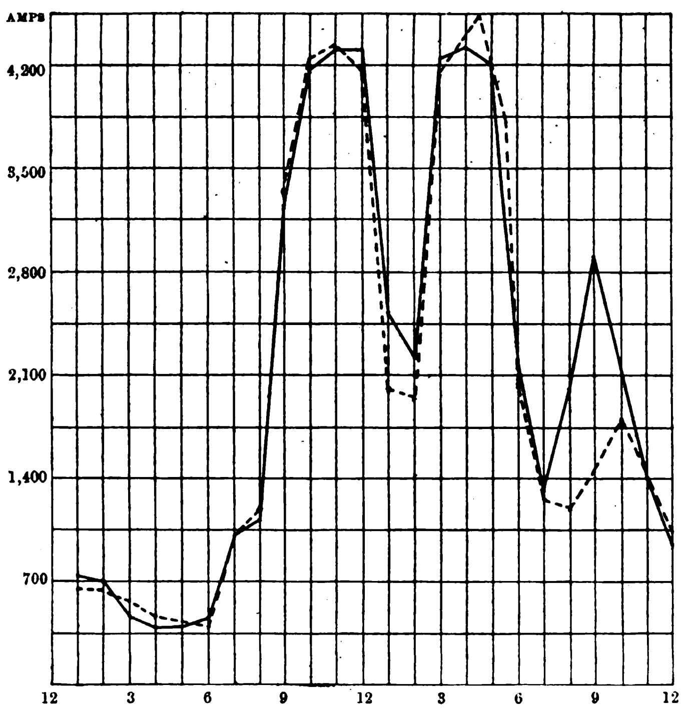


FIG. 2.—LOAD CURVES—BELFAST.

(In Figs. 2, 3, and 4 the full lines show the curves for May 15th, and the broken lines the curves for May 22nd, 1916.)

the fact that charges are usually higher for lighting than for power, which means that the reduction in revenue is greater than is indicated by the reduction in load. In the case of residential districts, where lighting is the main load, the latter consideration, of course, completely outweighs the former, and these are the districts in which supply authorities lose most heavily by the Summer Time Act. This has evidently been discovered by the Hampstead Borough Council, which decided last week to increase its charges for electricity by as much as 33 per cent. over pre-war rates.

Manufacturing districts, on the whole, do not appear to

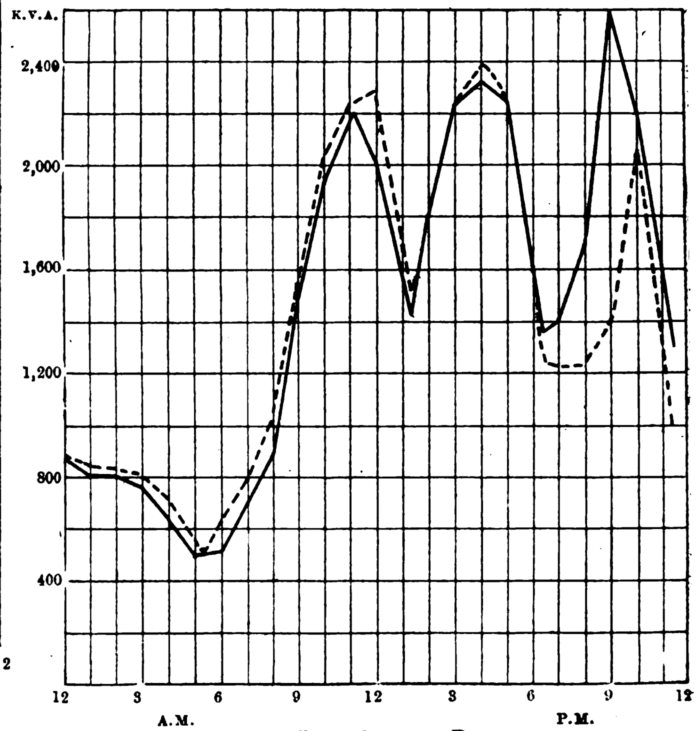


FIG. 3.—LOAD CURVES—DUBLIN.

be much affected by the change. This is probably due to the fact that the lighting load is such a small proportion of the whole that the reduction is inappreciable. This is probably accentuated by the amount of overtime being worked at present, and in the case of factories working all night the reduction is, of course, nil, as what is saved in an evening

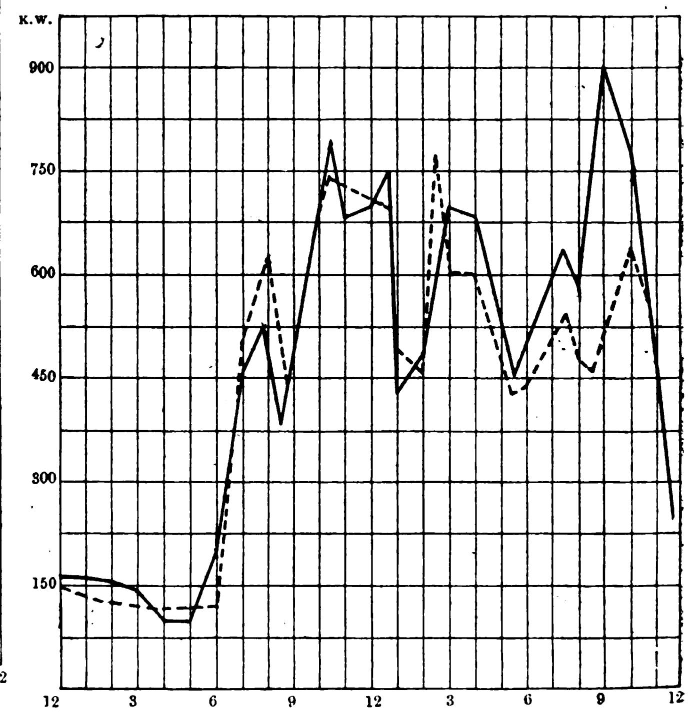


FIG. 4.—LOAD CURVES—SWANSEA.

is lost in a morning. In the case of Manchester the estimated reduction in output from the Stuart Street station for the period covered by the Act is equivalent to 1 per cent. of the total output, while the consequent saving in coal is about 600 tons; in the City stations the reduction is estimated at 2 per cent. of the output, with a saving in coal of 300 tons.

THE I.M.E.A.

THE annual meeting of the Incorporated Municipal Electrical Association took place at the Institution of Electrical Engineers on Thursday and Friday last week, Mr. A. C. Cramb, the President, being in the chair. Whilst the attendance was below that usually associated with the I.M.E.A. Conventions of pre-war years, a large number of members put in an appearance, and the hall of the Institution was well filled.

MR. F. M. LONG.
(Chief Electrical Engineer, Norwich, President, I.M.E.A.)

Without anything in the nature of an introductory speech or "welcome," the President proceeded to read his Address on Thursday morning immediately the members had assembled. We reprinted it in full in our last issue, together with a portion of the paper by Mr. Lackie on "Boiler-House Design," which followed. We give the remainder of the paper and an abstract of the long and interesting discussion which followed below.

An equally interesting discussion took place in the afternoon on Mr. H. S. Ellis's paper on "The Generation of Electricity on a Small Scale or Bulk Supply," which was also partly reproduced in our last issue, and is concluded with the discussion this week. The third paper on Thursday, on "The Uses of Electricity for Agricultural Purposes," threw a good deal of light upon what is being done in this connection in various parts of the country, and at the present time representations to the Board of Trade for improved facilities in the matter of wayleaves should have a sympathetic hearing.

The annual meeting on Friday occupied the full time allotted, and the more important matters discussed are referred to on another page.

BOILER HOUSE DESIGN AND OPERATION.

BY W. W. LACKIE (*Engineer and Manager, Glasgow Corporation Electricity Department*).

(*Concluded from p. 231.*)

The cost of lifting coal from canal barges or from trucks, and placing it overhead in coal-hoppers or in the coal store, is a small item in the total price of coal. In one Glasgow station we have a coal transporter fitted with a 1-ton grab. This transporter cost £2,600, and it handles coal at the rate of 40 tons per hour, and the cost of energy, labour, and repairs on it brings the cost of handling coal in this way just under 1d. a ton. In another station truck-loads of coal are elevated 30 ft. at one end of the coal store to an overhead platform, whence the coal is tipped into an overhead hopper or to the coal store, and the empty trucks lowered by a second elevator at the other end of the coal store. These two elevators, complete with electrically-operated capstans, cost £2,000. The inclusive cost of handling coal in this way is 3½d. per ton, the higher cost being due to the amount of labour necessary for handling the trucks. These figures are conclusively in favour of the grab and transporter. Where coal has to be carried a short distance from coal store to boiler-house, bucket or tray conveyors appear to be the right thing. On the other hand, for longer distances the telpherage system works out slightly cheaper, although the human element, with its attendant problems, enters more largely into it.

For the removal of ashes, bucket conveyors have proved to be costly in upkeep on account of the wear of the axles and pulleys, caused by the fine hard grit of ash dust, but even with this drawback, bucket or tray conveyors seem to be the cheapest method of removing ashes. Suction ash plant is finding much favour on account of the absence of moving parts in its design, but the capital cost is very much greater (about three times) than that of bucket conveyors. The cost for operating suction ash plant works out at about 5d. per ton handled, with energy at 1d. per B.O.T. unit. Suction plant is now made to do other work. It can be constructed for the purpose of elevating riddlings and small unburned fuel to a hopper or tank over the coal-conveying plant. It can also be made suitable for the removal of soot from economiser soot chambers and flue dust from the base of the chimneys. The atmosphere in which all these operations are carried on is greatly improved by the action of the vacuum plant.

A modern boiler-house calls for comparatively large overhead ash storage, from which ashes can be dropped into wagons or other vehicles for their removal to a coup. A few years ago ashes had a market value, and we could get as much as 4d. or 5d. a ton for them. Then a time came when we were glad to get rid of them free of charge. To-day we have difficulty in getting the ashes from our stations carted away for a payment of 2s. a ton.

Coal-weighing machinery for each boiler or group of boilers is absolutely necessary if proper records are to be made of the boiler-house efficiency. These weighing machines should preferably be fixed between the overhead coal hopper and the boiler stoker, but some stations in America have a travelling gantry, fitted with a weighing machine at each end, the gantry travelling along the whole length of the boiler-house between two rows of boilers.

Feed pumps may either be of the direct-action type or centrifugal, although experience with the former is so good and repairs so low that it will be difficult to displace them.

The total condensate from the turbine-room condensers should be measured by a Lea or other water recorder, and this should have an integrating attachment. Having ascertained the amount of coal used and having measured the condensate, we can get the amount of water evaporated per lb. of coal used.

No very great increase in the efficiency of steam boilers can be looked for. The heat balance of many of the steam plants in operation at the present day is as follows :—

Heat absorbed by boilers	78	per cent.
Heat lost in flue gases	15·5	,,
Heat lost in radiation and unaccounted for	6·5	,,

That is to say, the total loss on which any reduction can take place is 22 per cent., but it is only a small proportion of this figure which can be attacked with a view to lowering it. It would be doing negative work to discharge the gases from a boiler at a temperature lower than that of the water in the boiler.

An evaporation of 4 lb. of water per sq. ft. of heating surface in the boiler was, until recently, considered standard practice, but to-day water tube boilers are designed, in conjunction with special economisers, to evaporate at the rate of 6 lb. normal load, and at overload 8 and even 10 lb. per sq. ft. of heating surface of the boiler. The heating area in most water tube land boilers is of the order of 50 times that of the grate area. With such proportions the general practice is to emit the gases from the boilers at a temperature 500 to 550° F.—*i.e.*, from 100 to 150° F. above the temperature of the steam at the boiler working pressure. The proportion of heating surface in economiser to heating surface in boiler varies in nearly every station, but the figure of 35 per cent. may be taken as a fair average. With such a proportion, allowing for heat drop in flues, the gases at the outlet to the chimney will have a temperature of from 325 to 350° F., and the economiser will have utilised about 7 per cent. of the heat of the gases emitted from the boiler. The inlet water to the economiser from the hotwell will, with present-day practice, be raised to a temperature of 200 or 220° F. Until recently the evaporation per sq. ft. of heating surface of boiler and economiser combined was therefore roughly 3 lb. per sq. ft. of heating surface. Modern practice tends to diminish the heating surface in the boiler from 50 times the grate area to 35 times the grate area and to increase the area of the economiser to 80 per cent. of that of the boiler heating surface. The result is to put up the evaporation of the boiler at overloads to 8 lb. per sq. ft. of heating surface, and the temperature of the gases now emitted from the boiler is considerably raised, being about 650° F. The heat, however, is taken up in the economiser, and the temperature of the feed water to the boiler is considerably increased. The net result is that we get an evaporation of 4½ lb. per sq. ft. of heating surface of boiler and economiser combined. The overhead economiser is suitably proportioned to give the very highest combined efficiency. Boiler plants arranged in this way probably give a higher efficiency than was the case with previous designs, inasmuch as the radiation losses are less and the loss between the boiler and the economiser is reduced to an absolute minimum. The modern tendency is, therefore, to supply feed water to boilers at a temperature as near as possible to the temperature of the water already in the boiler, and the boiler simply adds latent heat and superheat to the steam. Each boiler has its own economiser, and the economiser is really an integral part of the boiler unit.

The kind of fuel to be used depends, among other things, upon the nature of the load, as it is a recognised fact that a higher

overload duty can be obtained from a boiler fired with good quality coal with a given draught than can be got with low-grade fuel. If a station has a purely lighting load, and consequently a low-load factor, a larger number of reserve boilers with their resultant radiation losses, &c., have to be kept under steam to meet any sudden peak loads, than would be the case in a power station where the load is chiefly for power purposes, and consequently the load factor is high. In the former case it is often more economical to use the best coal, because, with the higher overload thus made possible, the number of spare boilers can be kept down to a minimum.

It is now almost universal practice to buy fuel on a calorific basis, but it must always be remembered that along with calorific value and analysis there are to be taken into account physical properties. Two samples of coal may show an approximately similar calorific value figure and present wide differences of behaviour in the furnace. Actual boiler tests must therefore be made with sample truckloads of coal if the best and most economical selection is to be made. Anthracite coal with very high calorific value will only burn economically at the rate of 8 to 10 lb. per sq. ft. I would certainly not advocate a slavish adoption of the calorific value basis in the purchase of coal, for the simple reason that coal is not a manufactured article, but a natural product, and if we are to hold the colliery owner or his agent responsible for its calorific value, he will undoubtedly and quite properly cover himself by increasing the price accordingly. The contractor can be and should be generally tied down to supply from particular pits.

In the Glasgow Corporation Electricity Department the calorific value of the different kinds of coal offered is judged by the previous year's experience, and if any particular kind of coal as delivered is below our previous year's experience of it, then that coal has a decreased figure of value allotted to it against the time when next it will be again offered.

A practical test in a boiler specially equipped for the purpose is a very reliable guide to calorific value. It is usual to express the coal economic result for the whole station in lb. of coal per kw. hour generated at the switchboard, but as this must obviously vary with the calorific value of the coal and the steam consumption of the engine or turbine plant, the better unit to use for general comparison is the T.T.U. per watt hour, *i.e.*,

$$\frac{\text{lbs. of coal per unit} \times \text{B.Th.U. in coal as fired}}{1{,}000}$$

Even this is not perfect, as it does not allow for the variation in load factor between different power stations. In two of the Victoria Falls power stations the economic result obtained in the way proposed gave in one station 27 B.Th.U.s per watt hour and in another 26. Both of these stations had very high load factors, whereas in many of the London stations, where the lighting load is predominant, the average result is in the neighbourhood of 40 B.Th.U.s per watt hour. Daily samples of coal, as delivered, should be sent to the laboratory of the undertaking for calorific analysis. An assistant, working with a bomb calorimeter, can test twelve samples a day working from 9 to 1 and from 2 to 5 o'clock.

An interesting experiment has been carried out in one of the Glasgow gas works recently. Gas coke breeze or gas coke riddlings were burned successfully on chain grate stokers with forced draught. A special form of arch had to be built. This breeze can be bought at 20 per cent. the price of coal, and it has a calorific value of at least 60 per cent. of coal. There is a large amount of ash, but the experiment went to show that with intelligent superintendence good results could be obtained with this class of fuel, although the actual output of the boiler was considerably reduced.

With regard to the whole question of fuel, experience seems to show that it is preferable to buy the best, for while good results may be obtained with inferior fuel, careful and constant attention to the fires is necessary with such fuel, whereas with first quality fuel very little attention is required.

Twenty years ago a fireman in a generating station was truly a fireman. Stripped to the waist, he had in many cases to lift every pound of coal from the floor level to the furnace door. He had to be continually opening and shutting furnace doors and stirring up the fire. At regular intervals he had to bear excessive heat and noxious fumes, removing ashes from the furnace, which had thereafter to be wheeled away or shovelled direct into carts. All this has been or will soon be changed. The firing of the boiler is now done by operating a rope or a lever. A competent boiler-house engineer is an indispensable adjunct to the boiler-house staff capacity. He, of course, trains his own labourers, but the human element should be and is being cut down as far as possible.

Everything possible should be done to obviate wastage of the heat value of coal in the boiler-house before the steam reaches the turbine. A saving of 1 per cent. in the coal bill of the Glasgow Corporation Electricity Department would this year represent a sum of £2,000.

Recently, in the New York *Electrical World* (April 8th, 1916), a short but exceedingly interesting description was given of methods of handling boilers in a 100,000-kw. station of the Edison Electric Illuminating Company at South Boston. In this station, containing forty-eight boilers, they have thirty-six steam flow meters, forty draught gauges, two furnace indicators, one CO_2 recorder, two coal scales, and one load indicator. Several very fine records of efficiencies have been attained in America. At the Conner Creek plant of the Detroit Edison Company, which has been in operation for a year, they have two 20,000-kw. turbo-alternators, and each turbine is supplied with steam by two large boilers, each boiler containing 25,500 sq. ft. heating surface. The plant is operating at the present time and producing a kw. hour on 1·42 lb. of coal—*i.e.*, a little less than 20,000 B.Th.U.s per kw. hour. This shows an efficiency from coal to electrical energy of 17 per cent. The Chicago Commonwealth Edison Company in their Fiske Street station, have two turbo-alternators of 20,000 to 25,000 kw. capacity. Over a whole year's run the coal used per unit of output was 1·92 lb., and the average value of the coal as fired was 10,120 B.T.U.s per lb. This gives an average of heating units in the coal as fired per unit of output of 19,450, and also shows a thermal efficiency of some 17 per cent.

Discussion.

The discussion was opened by Mr. S. E. FEDDEN (Chief Electrical Engineer, Sheffield), who was particularly interested in the subject because he was himself laying down a new power house, which he hoped would be designed for no less than 100,000 kw. Mr. Lackie had said that the main object was to have the maximum steaming capacity in the minimum of space, but he hardly agreed with that. The first thing to be considered was the load factor upon which the station would be run in the future, for on this depended how much coal and ash would have to be dealt with. Sometimes, if development was to take place on the basis of a 70 per cent. load factor the capital expenditure on the present load would kill it. Against that there was the possibility that if the plant were laid down for a 40 per cent. load factor, probably in ten or twelve years time the load would swamp the capacity to take away the ashes. Therefore it was wise to buy the few acres extra of land. With regard to riddlings and the calorific value to be obtained from them this depended a great deal upon whether the grate was well covered, or whether the fuel burned off before reaching the dumping bars, so that there was only ash on the latter part of the grate. He had taken out some figures that on a well-covered chain grate the riddlings contained 9,596 B.Th.U., whilst on a grate that was only half-covered the value was 6,066 B.Th.U. The amount of CO_2 obtained also depended on how far the grate was covered. Passing on to the subject of automatic stokers, Mr. Fedden gave a few figures to show that the maintenance of these was much more costly the greater the calorific value of the fuel used. With a low calorific coal the figure came down to 0·46d. per ton. With underfeed stokers, which were useful for rushing up to meet a sudden load, the upkeep was 0·57d. per ton, but that figure would rise if any banking had to be done, and especially if there was much unskilled labour to look after them, because in banking an underfeed stoker, if the live fire was not taken off and put on the side of the dumping space and filled up with green fuel on the bars, a set of bars would be ruined. He also gave some figures for maintenance of bucket conveyors. With a conveyor taking washed coal the maintenance was 1·18d. per ton handled, but the moment coal that was not washed was put on that conveyor, the maintenance quickly rose. With a similar bucket conveyor handling the ashes the maintenance was no less than 17·76d. per ton. He believed that from the point of view of maintenance alone it would pay to put in suction conveyors, notwithstanding the absurdly high price charged for this equipment. He pointed out that it was inaccurate to get the amount of water evaporated per pound of coal used by measuring the condensate, because between the boiler and the turbine there were a number of losses. He found that he had to supply something like 15 to 20 per cent. more steam than was actually got from the condensate from the turbines. He also found that soot in the boilers accounted for one or two per cent. of the unaccounted for losses. An interesting point was the increase of ash in coal since the war. From one colliery the calorific value since the war began had decreased from 11,700 B.Th.U. to 9,700 B.Th.U., whilst the ash had increased from 10 to 25 per cent. From another colliery the calorific value had decreased from 11,000 to 9,800 B.Th.U., and the ash had increased from 11 to 20 per cent. Mr. Lackie seemed to have overlooked the use of the pyrometer for testing the exhaust gases from the boiler. This was a better guide than a draught gauge, as the temperature greatly increased from week to week as the boiler got dirty.

Mr. J. CHRISTIE (Chief Electrical Engineer, Brighton) said that Mr. Lackie had omitted to refer to the question of firing boilers in the "super-stations," which they hoped to see dotted about the country, by means of gas instead of coal. In the colossal power plants of the future the difficulty would be to find accommodation to house the steam-raising plant within a reasonable radius of the unit which it had to operate. Why not face this problem boldly by altering the fuel supply system, and on some suitable adjoining site provide coal stores, retort houses, and recovery plant for carbonising the coal on the low-temperature process, and lead the resultant gas as the fuel supply to the power house by pipe lines? Greatly increased boiler capacity could then be installed per square foot of floor space. Such an arrangement would provide an adequate supply of coalite

for use as fuel to meet all industrial and domestic requirements, thus solving the smoke problem in our large cities, and by the recovery of the rich tar, sulphate of ammonia, toluol, benzol, and other valuable residuals which are at present wasted, enable us in this way to foster new chemical industries in our own country to supply products for which before the war we were almost entirely dependent on Germany and other sources abroad. During the last few months he had had occasion to go into such a proposition on quite a modest scale for use in conjunction with their works, and he was now urging his Committee to complete negotiations with the British Coalite Co. to establish a plant capable of carbonising some 200 tons of coal per day, and from that he hoped to generate, by means of the residual gas which they would contract to purchase on most favourable terms, approximately 30,000 units per day at little more than half the corresponding cost for coal.

Mr. S. L. PEARCE (Chief Electrical Engineer, Manchester) agreed that getting the maximum steaming capacity into the minimum space was not the sole criterion, and that brought him to the question of the three-storey *versus* four-storey boiler house. Whether the economisers should be above the boilers or on the same plane resolved itself into a question of the relative space required for the boiler house and the engine room respectively. With them on the same plane as proposed for the Manchester Corporation, the lighter steel structural work more than compensated for the cost of the additional ground space required, also a much lighter boiler house could be obtained. At Barton the over-all width of the four boiler houses corresponded with the length of the turbine room, and he failed to see any advantage in adopting the overhead economiser arrangement, because it simply meant that there was a space between the various boiler houses of insufficient width to be of any use whatever. Twenty horse-power per square foot of engine-room floor appeared to him an excessive figure. At Barton he had about ten, and that value would hold good for units of about 20,000 kw. He did not think Mr. Lackie intended, as Mr. Fedden had suggested, that the riddlings and ashes were conveyed up into the bunkers again and sent down indiscriminately on to the various boilers. It was, however, an excellent plan to devote one or two boilers in a boiler room for the purpose of dealing with riddlings and ashes. The Paper gave an alternative arrangement for a boiler house with the firing from two sides, but he did not think it had anything to commend it. The modification of that scheme, which had been adopted in many American stations, where the boilers were fired from both ends with one coal bunker above, seemed preferable. Another point to be emphasised was the question of dividing up the coal bunkers as much as possible so as to avoid fires. There was a tendency in many power stations to neglect the boiler feed pumps. They were stuck away anywhere, and he had been very much impressed by the arrangement that was adopted in the new Paris station, where the pump hall was situated between the turbine room and the boiler house, and on the floor of the hall were placed the centrifugally-driven feed pumps. In conclusion, Mr. Pearce gave the following comparative particulars of some American and British boilers :—

DETAILS OF SOME LARGE WATER-TUBE BOILERS.

	Detroit.	Chicago.	Manchester.
Heating surface in square feet	23,630	12,250	11,000
Economiser ,, ,, ,,	none	9,500	5,000
Superheater ,, ,, ,,	—	612	3,924
Grate area in square feet	400	274	312
Evaporation in lbs. per hour	130,000	70,000	50/60,000
Consumption of fuel per square foot of grate area per hour	—	45 lbs.	21·25 lbs.
Gauge pressure in lbs. per square inch	200	210	225
Superheat	—	225°F.	275°F.
Diameter of tubes	4"	4"	3-15/16
Water evaporated per hour per square foot of heating surface	5·64	6·53	4·75
B.H.S./G.A.	59/1	44/1	35/1
Temperature of feed heater	—	250°F.	210°F.

He called attention to the comparatively small grate area in the case of Chicago. Evaporation in lbs. per hour was larger, but he had not the slightest doubt but what the Manchester boilers would be considerably more than the figures given. The consumption of coal per square foot of grate area in Manchester was purposely low in view of the long hours of operation contemplated.

Mr. JOHN ROBERTS (Durban) incidentally expressed the hope that some day the South African Association might become incorporated or affiliated with the Incorporated Municipal Electrical Association, and called attention to the great importance of simplicity in the boiler room, which was attainable by the boilers of a self-contained nature now obtainable, placed on one foundation similar to a turbine.

Mr. DAVID WILSON (Babcock & Wilcox) said that the chief point in future boiler design must be increased evaporation and reduced ground space. Boilers working at very high rates of evaporation required the utmost care as regards the feed water. In some Continental stations distilling plants were used for dealing with the make-up water. The correct efficiency of any of the established boilers was now fairly well settled, and the output became largely a combustion factor. The type of furnace was determined largely by an engineer's preference for forced or induced draught. He agreed with Mr. Lackie that with a normal coal market it did not pay to burn very low-grade fuel. In conclusion, he reminded the members that boiler makers were not sitting still, and it would impress many of them if they knew the amount of investigation work that was being done. In spite of the present conditions, the water-tube boiler was doing its bit in the direction of improved fuel economy, and if everyone worked together there would be considerable general advance.

Mr. C. H. WORDINGHAM agreed with Mr. Lackie that it was of vital importance to get a compact boiler house if they were to have large units. He doubted whether it was of real advantage to go in for such enormous sizes of turbo-generator units as were talked about in America - namely, 50,000, or even 100,000 kw., on account of the difficulties in the boiler house. Mr. Christie had spoken of gas-fired boilers. That was a matter he had gone very carefully into sixteen years ago, when he concluded that it was absolutely hopeless to attempt to compete with coal firing. Since then great improvements had been made, and he thought there was a great future on the lines Mr. Christie had mentioned.

Mr. W. M. SELVEY (Sheffield) said that the design of the boiler house was now the main feature of the power station, and that the engine room was only a small annexe, and the movement towards remote control which would separate switchgear entirely from the engine room made this annexe even more insignificant. It was very possible that they might return to the long, narrow turbine-engine rooms of the earlier American design. The railway sidings areas for coal storage towers were also items tending to make the question of the engine room relatively insignificant. The question of grate area per square foot of boiler-house space had, with the exception of the marine boiler of Messrs. Babcock & Wilcox, been insufficiently studied by boilermakers. Mr. Selvey then went into some detail over the design of mechanical stokers. The idea, he said, of a travelling band of a thoroughly mechanical construction with fire bars mounted on it, which take no strain, but only act as a platform for the coal, was gradually gaining ground. The movement in American stokers was, he thought, quite unsuited to British coal, and his opinion was that they wanted emergency-travel rates on the ordinary chain grate two or three times as fast as was then the case. Thickening up a fire was not the correct way to produce rapid combustion. The prospect of large gas-driven stations appeared to be receding more and more, and the difficulties in the way of producing a satisfactory gas turbine were enormous. Finally, straying rather beyond the purview of the Paper, he dealt with the possibilities of combination between the coal-owning and power-generating interests.

Mr. T. ROLES (Chief Electrical Engineer, Bradford), agreed with Mr. Fedden that the real question in the design of modern boiler houses was the load factor. The question of increasing the grate area somewhat should be looked into. An item in the Paper that had not been touched upon by previous speakers was steam pressure. In present-day boiler houses pressures of about 180 to 200 lbs. were employed, but now it would seem that these pressures must be increased. Turbine makers were taking to much higher pressures, one firm, he believed, now making experiments with a pressure of 350 lbs. per sq. in. The question of storing coal he believed had been taken up on a much larger scale on the Continent than in this country, probably because they were not able to obtain it so quickly from the pits or in such large quantities. At Bradford, however, it had not paid to put in special apparatus to store coal. It was just dumped in the works yard, and although it was a costly process to take it out by horses and carts it was cheaper than sinking capital in plant which would probably only be used once in about seven years. Experience at Bradford had shown it to be the best policy to buy the best quality of coal. He bought on the basis of B.Th.U., and a coal costing 15, 16 or 17 shillings per ton was very much better than one at 11 or 12 shillings per ton on this basis.

Mr. H. J. S. MCKAY (Stirling Boiler Co.) expressed himself as more in accord with Mr. Pearce's remarks concerning the two-storey building than with Mr. Lackie. With regard to Mr. Roles' remarks as to difficulties of 350 lbs. pressure, some years ago his firm manufactured some boilers for that pressure and experience with it allowed him to make the very definite statement that the only trouble encountered was with the water gauges.

Mr. J. H. BOWDEN (Chief Electrical Engineer, Poplar) said the opinions expressed in the Paper practically confirmed the experience at Poplar, where he had introduced the particular type of boiler mentioned in the Paper some five or six years ago. He was sorry to admit that he obtained that boiler from a country whose name we did not care to mention at the present time, but he saw things there which led him to the conclusion that that boiler was the only one he could put in at Poplar in the limited space at his disposal. With regard to the evaporation per sq. ft. of boiler space, it was interesting to

note that, although the author mentioned an evaporation of 10 lbs., in actual experience he was getting nearer 13 lbs. on the boilers that he had referred to. As to ashes he would like to suggest for consideration whether the removal of ashes could not be done in some manner similar to that adopted at sea, namely, to deal with them by pumping, in a similar manner to what they were doing with their coal, he believed, at Hammersmith. The figures in the test at the end of the Paper confirmed those obtained on tests of the boilers at Poplar.

Mr. G. WILKINSON (Borough Electrical Engineer, Harrogate) thought that Mr. Lackie was unduly sanguine in expressing the opinion that the ultimate development of the grate surface would be a combustion of 100 lbs. of fuel per sq. ft. of area. He had failed to find to-day any boiler house which in regular daily occupati n and work did more than 30 lbs. to 35 lbs. of fuel per sq. ft. of grate area. With a good water and clean surface, 70 lbs. of evaporation per sq. ft. of heating surface had been obtained, and there was no doubt that with regular working a rate of combustion of 35 lbs. could be obtained, but it could not be done with our present methods. He was surprised that Mr. Pearce in his new boiler house had only allowed for 4¾ lbs. of evaporation per sq. ft. of heating surface. This seemed a very low figure, because Mr. Lackie spoke of 8 and 10 lbs. He thought the solution of making progress in this matter was to deal with the heating in quite a different way. Mr. Christie had already foreshadowed a method, and that was by having a more flexible application of the heating element. He hoped the scheme at Brighton for using gas would be realised. Mr. Christie's difficulty would be that for the equivalent of every ton of fuel burnt in the ordinary boilers he would have about 12 tons of coke in the way of by-products to dispose of. If the associated company which was co-operating with Mr. Christie could sell that, well and good, but as central-station engineers they could not entertain anything of that description, because electricity works would then become coke-producing works, and the electricity would simply be a by-product and not the principal item. He would suggest that Mr. Christie should take the extra 60 per cent. of fixed carbon which was in the coke by burning it in the boilers, and reduce the coke right down to the ash. In that way a very fine efficiency would be obtained. Such firing meant cleanliness and no smoke, much simpler and larger boiler houses, better control, whilst the steam per sq. ft. of heating surface would be about quadrupled in large plants, and the valuable by-products should produce a revenue equal to approximately 30 per cent. of the original cost of the coal, or in small plants about 10 per cent.

Mr. J. P. GREGORY (British Thomson-Houston Company) spoke comparing the increased economy obtainable by using higher steam pressures and superheat, and referred to experiments carried out on the subject, and the discussion closed with a few remarks from BAILIE SMITH (Glasgow), who intimated that in Glasgow experiments in gas firing of boilers were in progress.

At the resumed meeting in the afternoon, the President announced that a conference had taken place between the Council of the I.M.E.A. and the Council of the Association of Power Company Officials on linking up. It was proposed to appoint a Joint Committee to go into this matter and report. This was a question that was likely to become very prominent in the next year or two, and Mr. Ellis's Paper had a strong bearing upon it.

The Generation of Electricity on a Small Scale or Bulk Supply.

Mr. H. S. Ellis (Borough Electrical Engineer, South Shields) then read his Paper on the above subject, an abstract of which was commenced last week (p. 231), and is concluded below:—

Having referred in detail to the steam consumption of steam turbines, it is perhaps only fair to make some reference to the steam consumption of modern high-speed reciprocating engines. In the smaller generating stations, where the largest unit is in the region of 750 to 1,000 kw., a steam engine set capable of developing 1,000 kw. at a speed of (say) 250 r.p.m. will consume at full load about 15·85 lb. of steam per kelvin when running condensing (26 inches vacuum) and with steam at 180 lb. per square inch, superheated to 550 degrees Fahr., which figure compares very favourably with those obtained from most steam turbines of similar output and under similar conditions. The figures for the smaller sets under similar running conditions are briefly as follows: 16, 16·4 and 19·3 lb. per kelvin for sizes of 750, 500, and 250 kw. capacity respectively. The results at half and three-quarter load exceed the above figures by about 5 per cent. and 10 per cent. respectively. There are places where an ample supply of circulating water for condensing purposes is unobtainable without the use of very large and expensive cooling towers, and where it would be found cheaper to instal reciprocating engines up to 1,500 kw. rather than to run turbine plant at a low vacuum.

The following table of total working costs per kelvin generated is obtained from the published figures per unit sold for a large number of electricity works, after taking off about 10 per cent. of the works costs to allow for (*a*) repairs and maintenance in connection with the distribution system, and (*b*) 15 per cent. for the distribution losses:—

COSTS PER KELVIN GENERATED.

Load in kw.	Works Costs.	Relative Works Costs.	Total Working Costs.	Relative Total Working Costs.	Load Factor.
	Pence.		Pence.		Per cent.
Up to 500	1·00	100	1·43	100	About 15
500–1,000	0·75	75	0·996	70	,, 15
1,000–1,500	0·64	64	0·846	59	,, 20
1,500–2,000	0·60	60	0·845	59	,, 20
2,000–4,000	0·51	51	0·668	47	,, 20
4,000–7,000	0·42	42	0·566	40	,, 25
7,000–10,000... ...	0·39	39	0·518	36	,, 25
10,000 and upwards	0·333	33·3	0·450	31	,, 25

A summary of the figures on which this table is based gives the following approximate results, which indicates the tremendous amount of waste in connection with the generation of electricity:—

Kelvins Generated.	Cost of Fuel.	Total Working Costs
1,300,000,000	£1,438,000	£3,363,516
	0·265*d*. per Kelvin.	0·62*d*. per Kelvin.

It is not within the scope of this Paper to deal with the question of electricity generated by electric supply companies, private individuals, railways, &c., as well as the municipalities already referred to—which supply probably exceeds many times that indicated above. Had such a thing been possible, it might not have been a difficult matter to show how, by means of centralisation of supply it would be possible to reduce the above figure, 0·265d., by (say) 25 per cent. (not to mention the total costs figure, 0·62d.), and so effect a saving of upwards of £1,000,000 on coal alone. The natural argument against such a statement as the above would be that centralisation could not deal with more than a small percentage of these undertakings owing to their geographical position.

This paper must necessarily include some reference to capital costs—not only of plant already installed, but of plant to be installed—in order to compare figures of the total cost of supplying electricity from large and small power stations. For this purpose reference has been made to the figures appearing in "Garcke's Manual." The results obtained are as follows:—

COST PER KW. INSTALLED OF GENERATING PLANT, LAND, BUILDINGS, &C.

(Nothing is included for anything outside the generating station.)

Load in Kilowatts.	Cost per kw. of Generating Plant Installed.
	£ s. d.
Up to 500	40 0 0
500–1,000	27 0 0
1,000–1,500	25 0 0
2,000–4,000	22 10 0
10,000 and upwards	20 0 0

The impression created on glancing at the above figures is that the smallest undertakings have not been able to benefit by the low costs per kilowatt of turbine plant. This is no doubt a fact, because it has already been shown that below about 1,000 kw., turbine plant does not compare favourably with reciprocating plant as regards steam consumption. Therefore, the capital cost per kilowatt in such cases remains high owing to the presence of reciprocating plant. Furthermore, in the case of those stations where turbine plant has been installed, the capacity of the plant installed has been increased by perhaps hundreds per cent. without a single extra pound expenditure on land and buildings. As an example of what this means, it may be interesting to make reference to two instances within the author's practical experience—namely, (*a*) at Bradford three 3,000-kw. turbine sets were installed on a site originally laid out for a 1,000-kw. slow-speed engine set; and (*b*) at South Shields two 2,000-kw. turbine sets superseded three engine sets of a total capacity of 400 kw.

The following curve (Fig. 3) emphasises the above state-

ments, and gives a very fair idea of the future possibilities of generating cheap electricity. It shows how the steam-engine set holds its own against its competitor in the sizes from about 750 kw. downwards. The figures also show that

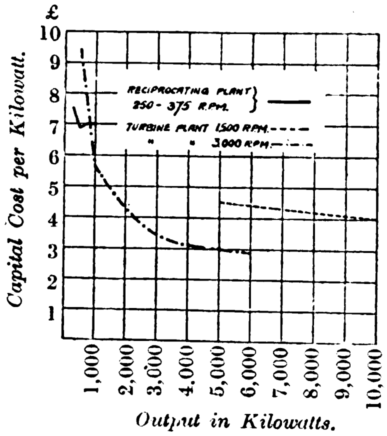


FIG. 3.—CAPITAL COST OF ELECTRIC GENERATING PLANT (INCLUDING TURBINE OR ENGINE, GENERATOR AND CONDENSING PLANT).

there is nothing gained, as far as the cost per kw. of turbine plant is concerned, by adopting the larger sizes, since owing to the reduced speed of the larger sets (1,500 r.p.m. as against 3,000 r.p.m.) there is quite an appreciable increase in the cost per kw. Hence, in the case of South Shields already cited, it was possible to instal turbo sets of 2,000-kw. capacity which probably cost no more per kw. than the large sets installed in the generating station of the Newcastle Electric Supply Co., and without spending a single penny on land, buildings, &c. It is in such cases as these that it will be extremely difficult to make out a favourable case for supplying *in bulk*.

With regard to steam generating plant, a glance at the

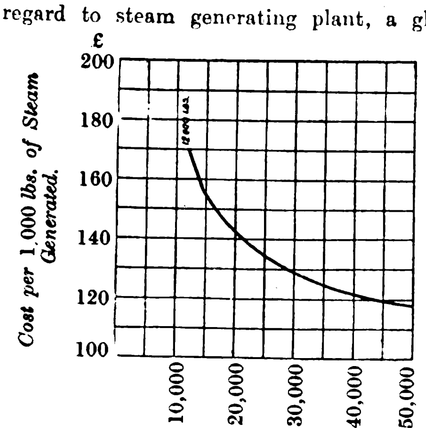


FIG. 4.—CAPITAL COST OF STEAM GENERATING PLANT (INCLUDING BOILER, SUPERHEATER, STOKER, FITTINGS, &C., ECONOMISER, BOILER AND ECONOMISER BRICKWORK. FOUNDATIONS NOT INCLUDED).

following table and Fig. No. 4 will suffice to show that, as far as the boiler-house plant is concerned, there is nothing like the same relative difference in cost between large and small units as exists in the case of the engine-room plant, although it should be pointed out that the figures do not include buildings, foundations, coal bunkers, conveyors, &c.

RELATIVE COST OF STEAM GENERATING PLANT, INCLUDING BOILER, SUPERHEATER, STOKER, ECONOMISER, BOILER AND ECONOMISER BRICKWORK AND ALL FITTINGS, LADDERS, GALLERIES, DOORS, &C.

(Steam, 200 lb. per sq. in.; Superheat, 200° F.; Coal, 12,000 B.Th.U.)

Evaporation from and at 212° F.	Relative Cost.	Cost per 1,000 lbs. Steam.	Cost per kw.*
		£	£
12,000	100	170	3·4
20,000	84	142	2·85
30,000	77	130	2·55
40,000	72	122	2·45
50,000	69	118	2·35

* All these figures are calculated on the basis of 20 lbs. of steam per kw.h., and they should be corrected to suit any particular cases under consideration in which the steam consumption of the generating plant, auxiliaries, radiation and condensation losses, etc., vary to any considerable extent.

Every electric supply engineer knows that it is quite possible nowadays under normal conditions to put down a very large power station (say 100,000 to 200,000 kw. capacity) for about £10 per kilowatt of plant installed,* and it is more than likely that this figure might under very favourable circumstances be reduced to £8 per kilowatt. It can also be shown that a small station (say 2,000 kw. to 5,000 kw.) would not cost more than £20 per kilowatt, and a very small station (below 2,000 kw.), £30 per kilowatt.

Fig. 5 shows what might be done, under normal conditions, in the way of generating electricity on a large scale. In order to have some basis to work on, the figure 0·265d. has been taken as being a fair figure for total working costs in a station having a load of 80,000 kw. and a load factor of 25 per cent. This figure is split up into various items of cost, which in turn are divided into fixed charges and running charges. The curve shows the total cost of production at the switchboard only, and does not make any provision for capital charges of transmission system, transmission losses, conversion losses, etc. It must not be forgotten that the curve above referred to represents the case of a station laid out with the most modern plant, fully loaded and unsaddled with capital charges on old plant or any other disadvantages under which all the largest undertakings are working at the present time. In other words the curve represents an ideal state of things which can only be arrived at providing all, or

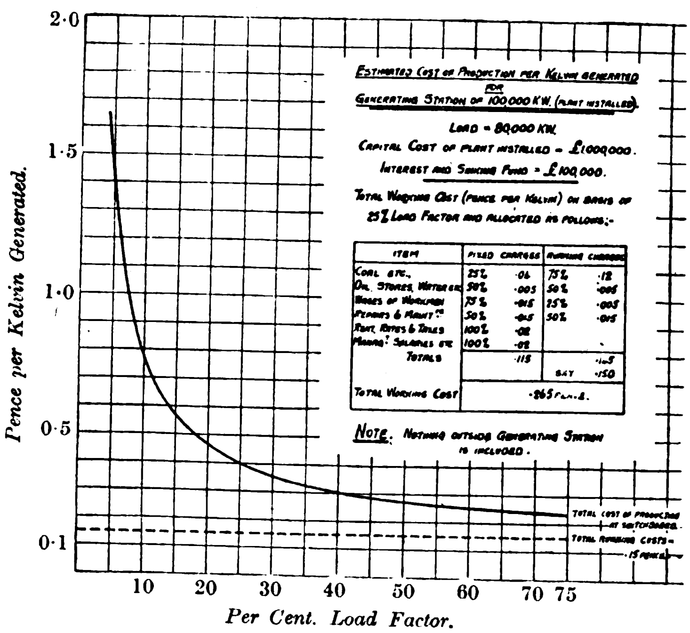


FIG. 5.

at any rate most, of the existing undertakings agree to sink their individuality in that of the larger scheme.

This paper would not be complete without some reference, necessarily brief, to the transmission of electrical energy to the various points of distribution which in case of a bulk supply system would be situated some considerable distance from the generating station. There does not appear to be any serious difficulty in the way of a bulk supply scheme from the point of view of transmission, except as regards the capital cost which in the case of a large system, such as is referred to in this paper, might very nearly equal the capital cost of the generating station, it being extremely doubtful whether full advantage could be taken of overhead transmission lines owing to the nature of the districts surrounding the great towns in which the bulk supply stations would be situated. It is also doubtful whether any responsible public electric supply engineer would care to run the risk of being entirely dependent on overhead lines for his supply. The disadvantage of the adoption of high-pressure transmission is that step-up, as well as step-down, transformers would have to be used, with the result that the transformed losses alone would amount to a considerable sum per annum. That this is not an item which can be neglected is appreciated on referring to the discussion on Mr. P. V. Hunter's paper† on "Static Sub-Station Design," in which it was pointed out that on the Tyneside Power Company's system the transformer core losses alone amount, owing to the large amount of reserve static

* Manchester (Barton) Scheme, which allowed for a complete installation of 160,000 kw. of plant, was estimated by Mr. Pearce, City Electrical Engineer, Manchester, to cost £1,775,000, or £11 09 per kw. installed.

† *Journal I.E.E.*, vol. 46, p. 481, 1911.

plant, to not less than 10,000,000 units per annum. In addition to the above losses it is necessary to allow for the losses in the cables, due to capacity currents and dielectric losses (which are independent of the load), and also the losses due to the load, which is variable, not to mention the heavy losses which will undoubtedly be incurred in cases where it is necessary to convert the three-phase energy to direct current or alternating current at a different periodicity to that of the bulk supply system.

The author is of opinion that by the time all these things have been taken into account it will be a very difficult thing to prove that an isolated bulk supply authority is in a position to generate and distribute electrical energy at a price which will allow of a reasonable profit, not only for the supplier but for the distributor, although the case might be altered materially by the linking up of other large undertakings, in which case the capital cost per kilowatt (load) could be substantially reduced.

It would appear that the first thing to be done would be to appoint a committee consisting of members of the I.M.E.A., such committee to be representative of not only the larger undertakings but of the medium and smaller undertakings. This committee should have power to co-opt members of other scientific societies, such as the Institution of Electrical Engineers, the Institute of Chemistry of Great Britain and Ireland, etc.

The duties of such committee would be to make a thorough investigation into the whole subject of electricity supply, with a view:

(*a*) To standardise as far as possible the generation and distribution of electricity throughout the whole country.

(*b*) To conserve the supply of fuel used in electricity works and to make a thorough investigation of the important question of extracting from the coal valuable by-products, such as nitrogen, tar, oils, &c.

(*c*) To make use of waste heat wherever possible.

(*d*) To cut down the percentage of spare plant by judicious linking up of adjacent networks. (There are numerous instances where this could be done right away.)

(*e*) To promote legislation whereby facilities may be obtained such as are absolutely essential to the scheme and such as do not exist to-day.

Discussion.

Mr. J. A. ROBERTSON (Chief Electrical Engineer, Salford) said that the question of the small- or medium-size station *versus* large stations could not be decided simply by taking records of works costs as published. One of the chief items was rent, rates, and taxes, which varied by as much as 600 per cent., and was an item over which the engineer had no control whatever. The same remark applied to management charges. He would, however, only deal with one or two main points. In Mr. Ellis's curve it would be seen that there was a drop in steam consumption of from 96 to 86 from the 1,000-kw. turbine to the 2,000-kw. turbine; then there was a straight line from the 2,000-kw. to 5,000-kw., then a drop for the 6,000-kw., and a straight line again up to 10,000-kw. He did not know where Mr. Ellis had got his information from, because he had figures from a very well-known firm of manufacturers which were perhaps worth noting. For a 1,000-kw. turbine at 3,000 r.p.m. with steam at 550° superheat and a vacuum of 28 in., the consumption was 14·8 lbs.; for a 2,000-kw. size it was 14·7 lbs., for a 3,000-kw. it was 13·2 lbs., and for a 5,000-kw. it was 12·7 lbs. All were running at 3,000 r.p.m., and were in actual use. There was a difference of 15 per cent. between the 2,000-kw. and 5,000-kw. size instead of the straight line as shown in Mr. Ellis's curve, and, even admitting that 3,000 r.p.m. was a high speed for a 5,000-kw. set, the 1,500-r.p.m. machine had a consumption of 13·4, or an advantage of 9 per cent. over the 2,000-kw. size. If a station employing 3,000-kw. sets had been brought up to date, and if its area of supply was fairly compact, then there was nothing in the way of bulk supply that could improve the costs. There were half-a-dozen stations in the Lancashire area that were producing energy, with load factors not too high, with figures of cost that were better than any figures yet published for large municipal or company stations. Without dealing with the larger stations, however, there was very little to choose between a 20,000-kw. or a 25,000-kw. station, and anything yet estimated for 100,000 kw. It was known that a station with sets of 5,000 kw. or even 3,000 kw. could come very close to the ideal costs which had been heard of for the super-stations yet to be built. He had not much faith in the suggested Committee of the Association being able to do much in the matter. It was a problem to be dealt with at once. They were short of plant in all the stations in industrial districts, and the Treasury, acting through the Local Government Board, had practically vetoed all expenditure on new stations. After the war matters would certainly be no less difficult for some little time, yet they would be face to face with a very large demand for power, and it was this which was the problem at the present moment. The reorganisation of British industries all round must take place if we were to maintain or improve our position in the markets of the world, and the supply of electrical energy would play an important part in this reorganisation. A linking-up movement had been started in Lancashire. In whatever way it was tackled, the problem must be dealt with from the point of view of each district and the districts that were to be linked up. When this was done it would probably be found that it would be possible to run these districts on a load factor of nearly 100 per cent., owing to the less efficient plant standing idle or being used only at times of peak load.

ALDERMAN LITTLER (West Ham), who mentioned that he had now retired from municipal life, was afraid that in the London district municipal jealousies had to a considerable extent prevented a satisfactory development of electric supply in and around London. The problem of linking up existing stations would become very much more pressing, having regard to the necessity after the war of looking at this question from the interests of the country as a whole. A scheme was required which would combine the great commercial driving force of a company with the broadened outlook of the municipality and seeing only what was good for the country irrespective of whether it produced dividends or not.

Mr. E. T. WILLIAMS said that if by linking up the small stations they were going to lose the bigger scheme, it would be a great pity. If linking up meant perpetuating a great many small stations which ought to be wiped out, then linking up must be very carefully dealt with. Whilst there should be every encouragement for schemes such as Mr. Ellis had put forward and the splendid work of Mr. Robertson in Lancashire and Cheshire, not to mention those who had started linking-up schemes in London, he pleaded that whilst going carefully along they should not continue to extend electricity supply as company supply, municipal supply, or anything else in local areas, but there should be a united effort to work out that larger scheme which had been so much talked of.

Mr. J. W. MEARES (Electrical Adviser to the Government of India) said the author's analysis of the working costs agreed very fairly with a similar table printed in his book, recently published in India, and referred to some of the conditions under which electric supply is carried on there.

Mr. C. H. WORDINGHAM said that unrestricted quantities of electricity would obviously be a boon to everybody, but the question was whether that supply was to pay or was not to pay. In other words, was the individual who used the electricity to pay for his own business, or was the community at large to pay for a portion of it. That took one at once into the region of politics, and was really the question of individualism *versus* socialism. The author had put his finger on the chief point in the problem to be solved—namely, that the industry was not starting with a clean slate. There was already invested in the industry an enormous amount of capital, and although it was all very well to run down the small, inefficient, and inadequate stations, after all, if it had not been for these stations and for the enterprise of those who put them up, there would have been no electricity-supply business whatever at the present time. What was to be done was not to invent ideal conditions to suit the solution they wanted to put forward, but to find a solution to meet the conditions which actually in fact existed to-day.

Mr. J. S. WATSON (Chief Electrical Engineer, Bury) said that although a good deal could be said for the argument that small power stations by developing along the lines of large units might become quite economical for distribution, a good deal could be said from the other point of view. It depended not only on the ability to provide larger-sized plant in substitution for existing plant, but also on the suitability of the site for the economical operation of that plant, on the water facilities, and also on the ease with which it obtained and used its supplies of fuel. Local linking up would tend to develop the existing resources to a better extent than had previously been possible, which was, in his opinion, only one step in the direction of carrying out the larger scheme, and by that he had in mind that if linking up was developed, certain boards or committees would be set up with such powers that they could say whether undertakings should be extended or whether, owing to the less suitable site, for instance, undertakings should take their supply from a larger one outside the district.

Mr. W. B. WOODHOUSE (Yorkshire Electric Power Co.) felt that the only real line of development was the process of linking up existing organisations and using them to the utmost extent in order to lead up to the national supply system that was aimed at. The local experience already gained of local conditions would be utterly wasted if they started at the other end and created a municipal or State electricity board who knew nothing whatever about the local conditions.

Mr. J. H. BOWDEN (Chief Electrical Engineer, Poplar) said a great deal had been heard about the linking up, but very little about bulk supply, but there was a very wide difference between bulk supply and the advantages to be obtained from

linking up. Some of them in London had advocated linking up for eight or nine years. The Poplar station had been linked up with Stepney for six years. It was now linked up with Hackney, and negotiations were in progress for linking up with the South Metropolitan Company and also with West Ham. Advantages could be claimed under three heads: firstly, standardisation of supply; secondly, reciprocal supply; and thirdly, bulk supply. Long ago he decided that, as far as Poplar was concerned, bulk supply would be practically useless. As was known, there was now an arrangement with Stepney that neither should spend capital on new plant until one station or the other had reached a certain capacity and utilised all the plant which had been installed. It might be argued as regards linking up that the capital expenditure would not bring the advantages which he had claimed unless some definite bulk supply was taken, but he was strongly of opinion that the advantages gained in the reciprocal supply and shutting down during the night and light loads and the joint facilities for overhauling amply repaid the expenditure.

Alderman Sinclair (Swansea), speaking on the question of the advantages of bulk supply, mentioned an agreement recently entered into between the Swansea Corporation and the Swansea Tramway Co., which, he said, was to the mutual benefit of both parties. Having succeeded in making the agreement with the tramway company, he was now preparing to tackle bigger things.

THE APPLICATION OF ELECTRICITY TO AGRICULTURAL PURPOSES

By W. T. Kerr, *City Electrical Engineer, Hereford.*

Up to the present time the use of electricity in farming has not attracted the attention that it undoubtedly deserves in this country.

This is the more surprising in view of the important and extensive schemes for supplying agricultural areas which have been carried out in other countries. Germany, France, Italy, Austria, Switzerland, Denmark, Holland, etc., all afford practical examples of farm supply on a fairly extensive scale. But probably the greatest aggregate of agricultural consumers is found in the United States. It is noteworthy that California—a purely agricultural State—uses more power per head of population than any other American State. Canada also furnishes an interesting example of farm supply on the Ontario Hydro-Electric Commission's extensive distribution system, and practical examples of a similar kind are to be found in Australia, New Zealand and elsewhere. There is awaiting development in this country an enormous business of a similar kind. The writer's conclusions are based on some years' experience in farm supply work in the neighbourhood of Hereford.

The following examples are given of such applications on the Continent: "The rural station of Besswitz has a distribution system 145 miles long, and, the central station being as nearly as possible at the centre of the network, the greatest distance of supply from the station is twenty-six miles. The territory served is 102,000 acres in extent, of which 40,000 acres are cultivated with the plough. To this network are connected 180 motors and 5,000 lamps, with a total consumption of 1,300 kw. On another German private installation there are connected four grist mills, with five motors aggregating 105 h.p.; one tile works, with a 40-h.p. motor; one saw mill, with a 20-h.p. motor; and 20 consumers for lighting only, with a total of 343 incandescent lamps and six arc lamps. The Oerlikon Co., of Zurich, issues a special catalogue on the subject, showing applications of both alternating and direct-current motors, both stationary and portable—the latter mounted upon a handbarrow with a reel of cable for connecting to the supply. Some engineers in the United States have even gone so far as to incorporate the motor in the farm machine, in the same manner as in modern machine-tool work."

The last report of the Ontario Hydro-Electric Commission contained some particulars of farming supply in Ontario, with data as to energy used on farms; the average yearly consumption per farm for all purposes was 4,700 units, and the average revenue £27.

In the Hereford district a system of light transmission lines has been erected to reach the agricultural consumers. These are built with larch poles, 28 ft. long, with cross-arms of quarter oak 2 ft. 6 in. by 3 in. by 3 in., the bottom arm 3 ft. The lines are usually now made up of 7/10 B.S.G. bare stranded aluminium, weighing about ·032 lb. to the yd., and costing before the war 1s. 0¼d. per lb., with two No. 12 galvanised guard wires below, which are also used as the neutral, the supply being given at 440 volts, three wire. The total cost, including labour, works out at £110 per mile. These lines have withstood the gales of December, 1915, and March, 1916, without a breakdown. The farthest distance a supply is given is 3,400 yds. from the generating station, 1,200 yds. of which is by overhead lines; these radiate in five districts from the station to an average distance of 3,000 yds. When erecting the poles, it has been found better to place them close into the hedges, otherwise the cattle use them for relieving themselves of insect life; also farmers object to their being placed any distance out in the fields, and the hedges and ditches act as a guard. Such lines can be arranged with quite long spans, 75 yds. in places, to cut across corners, if the route is carefully considered before the erection.

Tappings to consumers are taken off by means of a twin-lead cable clipped to the pole, and connected to the overhead wire by rubber wires through a small type sealing box. The connection to the aluminium wire is made by means of a "jim crow" shaped clip, which grips the wire in two positions, the lead being sweated to a screw used for tightening in the centre, and the whole joint afterwards painted over with aluminium paint; no trouble whatever has been experienced with such a joint, although one section has been in constant use for nine years, connecting up a supply to a 50 h.p. motor.

In an average case, a 10 h.p. motor will meet all the power requirements of a farm, except for thrashing and cider milling, but motors up to 20 h.p. have been hired out for these purposes, which are only seasonable jobs.

The greatest obstacle to cheap rural supply is the question of way-leaves; when it is necessary to go outside the boundary of a Provisional Order area to supply in a district without such an order, many unnecessary legal difficulties are encountered.

Among the motors employed on a Hereford dairy farm is one working a vacuum pump for the milking machinery, requiring 1½ h.p. This machine is used twice daily, for about two hours in the morning and one and a quarter hours in the afternoon. The cows milked average about seventy, and the machinery has a capacity of eighty-eight. The farm bailiff states that it would require five men at least, who are expert milkers, to do the work in the same time, or with his present staff, five or six hours a day longer.

In the same installation motors are used in a sterilising and filtering room, also for root pulping and chaff-cutting machines. The machines are so placed in order to keep out all the dust which generally arises when dry hay is being cut. The roots are thrown over into the machine hopper, and the chaff comes down the shute on the wall, the two are mixed and fed fresh to the cattle. Experience shows that owing to the easy starting of an electric motor the exact quantity of food can be cut and mixed fresh as required, a very important result being a greater yield of cream in the milk. A machine for kibbling corn and rolling oats is installed, also a circular saw for splitting wood and fencing material.

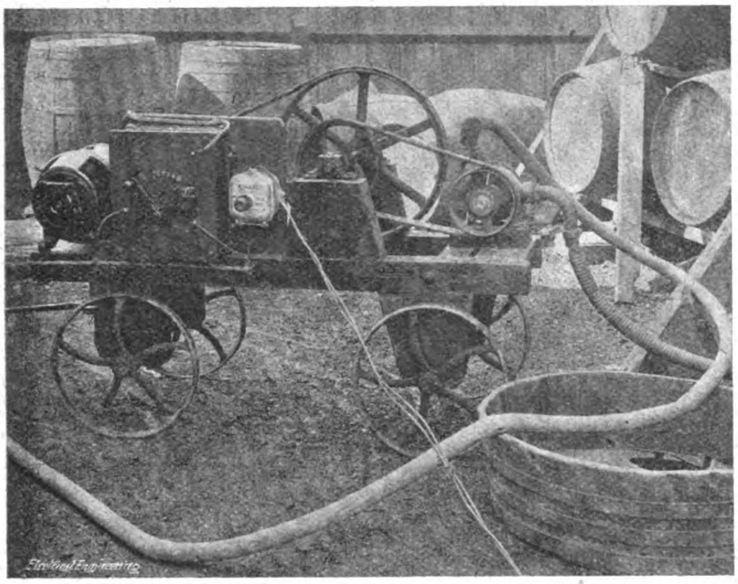
The units consumed on this farm for year ending 1915 amounted to 2,411, at 2½d. per unit. and the revenue reached £25, or an average of 9s. 7d. weekly. The quarterly energy consumption for power was: June, 369; September, 746; December, 665; March, 631.

The use of electricity from the farmers' standpoint means a considerable saving in labour, although the operations could be performed, as on many other farms, by oil or gas engines. Engine stopping and starting, however, requires time, and it would also be necessary to send men and carts for oil or coal to the nearest town or railway station, the cost of which should be taken into account.

Illustrations of most of these machines are given in the Paper, also a view of an old stone cider mill in Hereford used to crush apples. Another illustration, which we reproduce, shows a portable pump used for filtering and racking cider. This portable pump is also used for shearing sheep, by a connecting flexible shaft driving the cutters to either side of the counter shaft-space, regulating being done by the controller in the motor starter. Machines are used for the drying of spent apples after the juice has been extracted, and the apples afterwards used for cattle food; one large machine of this description requires about 25 h.p., and runs for three months, twenty-four hours daily, with as few stops as possible. The same motor is used for sawing wood during other months of the year. Similar drying machines are used for grains and spent hops, the grain being used as a cattle food and the spent hops for bedding, while the seeds from the hops are used for the preparation of a dye stuff.

In the greater part of the hop-growing district the demand per farm would run up to 25 h.p., which would be used for spraying the hopyards, driving fans and pocket-filling presses; it is possible that electroculture would be of assistance in extinguishing blight, and this would open up a field of incalculable value.

The introduction of electrical ploughing, and of electrically-driven wagons for the general hauling work, is a possible development of the near future. It requires about 1·5 acres of land to provide food for each horse kept on a farm, and the horses sometimes cannot be used for many weeks together owing to weather conditions. From a mechanical point of view, it would not be a difficult matter to design a machine that could be used alternately to plough, or to drive a thrasher, and which could be run into position to drive the general farm machinery. With a suitable pulley and geared counter-shafts for varying speeds, 10 to 12 h.p. would cover the power requirements for all usual operations. But the vital necessity is a permanent power supply available in the farm. The ordinary size of battery used on an electric vehicle would be sufficiently large to plough a good many acres of land, and could be charged in the usual way at night, with a boosting charge during the day if necessary. A petrol-driven two-furrow plough weighs about 20 cwt., and develops about 11 h.p., requiring about two gallons of petrol, or benzine, per acre, with a certain amount of lubricant. The total weight of a battery on a one-ton van, for a 50-mile radius, is about 1,260 lb., giving a speed of 12 miles per hour; the total weight of the chassis is 3,400 lb., and if we substitute the plough blades, for the weight of a pair of wheels and gear it to travel about 120 ft. a minute, it would be fair to assume that a battery-driven plough is not an impossible machine. The battery charge capacity being equal to 18 kw, the cost would be very low, at usual power rates, per charge.



PORTABLE PUMP FILTERING CIDER.

The *Electrical Review* of February 11th, 1916, contained a description of an electrical ploughing gear driven from overhead lines on a Nottinghamshire farm; most farms have a certain area of arable land permanently used for cropping, round which light overhead lines could be erected to certain points, and by means of a trailing cable carried on a drum, geared with the speed of the plough to pay in and out (the cable being sheathed with tough rubber compound), the double winding rope hauling ploughing gear of the usual type could be dispensed with, and a plough carrying a single motor and controller used. The slow rate of speed of a plough along a furrow would not endanger the life of a trailing cable.

Electric ploughing on an extensive practical scale has been carried out in Germany, Sweden, Italy, and France, the results being usually stated to be in favour of electricity as compared with either animal, steam, or oil ploughing tackle. German investigators have declared that for really heavy ploughing, the only competitor of steam is electricity. Much of the published data regarding ploughing costs is, however, not really comparable, as the local conditions, depth of ploughing, &c., greatly influence the results obtained.

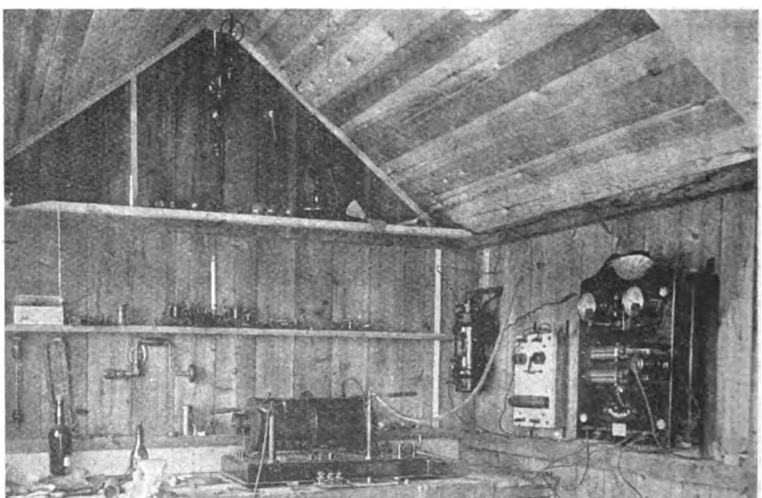
In the Hereford supply area, the district is typically agricultural. The horse-power of motors in use and units consumed generally in carrying out the operations are as follows:—Cider making, 160 h.p., 67,404 units; milling, 142 h.p., 347,856 units; farmers' supply, 106 h.p., 19,673 units; water pumping, 157 h.p., 331,295 units; sawmilling, 130 h.p., 22,801 units. A curve of the daily output for one week is given on p. 248.

A scheme of high-tension three-phase supply has been prepared for the Hereford area, which it is proposed to carry out after the war, there being a growing demand for electricity from farmers and private residences that cannot be met by a 440-volt three-wire supply. There are as a rule five farms to the mile along an average road; there are also many ordinary country residences. We can estimate an average revenue of at least £100 per annum from the five farms, and anything from £20 to £200 from the private houses. Large country residences are only too anxious for such a permanent source of supply, and sixpence a unit could be quite easily obtained.

A few notes have been taken of the consumption and generating costs of several large mansions in the Hereford area, of which the following is typical:—

The installation consists of engine (oil) of 16 b.h.p.; battery, 54 cells of 400 ampere hour capacity; 300 25 c.p. lamps installed. Average cost of "Royal Daylight" oil for twelve months, 10d. per gal.; $2\frac{1}{2}$ units of electricity delivered into house for every gallon used—4d. per unit for oil. There were also 25 gallons of cylinder oil used at 3s. 2d. = £3 19s. 2d. The cost of small repairs, battery, bolts, brushes, but not including repairs to wiring in the house amounted to £4 12s. 3d. Wages of man to look after engine, &c., 28s. per week, plus house and coal, 10s. per week = £98 16s. An allowance of 15 per cent. depreciation must be made on cost of the battery.

In all such private installations the current consumption could be increased considerably. It will be found that generally those responsible for running these small lighting plants deprecate their use for anything but lighting, with the result that for power and other purposes numerous small oil engines are being run in out of the way places, for instance, for water supply, ice making, stable work, &c. Electric cooking and heating offer enormous possibilities if a permanent supply were available, and it is no exaggeration to say that such a supply will be received with open arms by the residents, who are under no misapprehension as to being able to produce electricity cheaper themselves. Such consumers have heard so much about the "battery will not do it," and paid so many repair bills, that they will take the first opportunity to get rid of the private generating plant. The average revenue in such a case should amoust to between £150 and £200 per annum; the owners in most cases would be quite willing to meet the cost of the service extensions, running over their own estates, from the main supply, or agree to a minimum charge of 10 per cent. on capital cost of extension, with a kilowatt demand and small charge per unit.



ELECTRO-CULTURE APPARATUS FROM SUPPLY MAIN. AUTO CONTROL WITH TIME-SWITCH.

Dr. Ferranti and Mr. Chattock have pictured a future in which electricity supply will be run in the national interests, and the country will be served by a network of transmission

lines. Such lines will in most cases have to pass through agricultural districts, which, if properly exploited by the existing supply authorities, would be in such a state of development that a paying load could be obtained along the route to commence with.

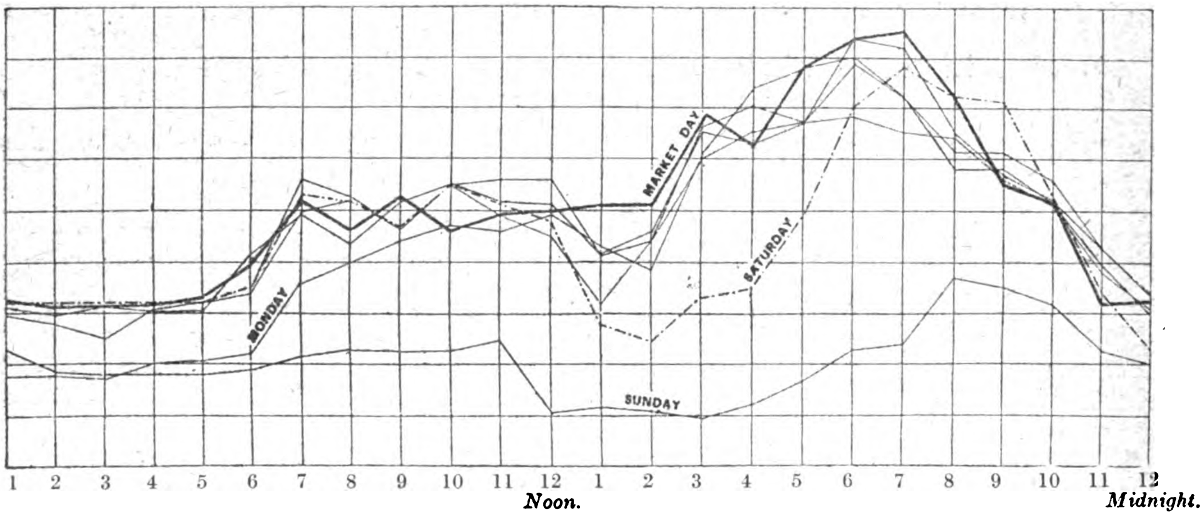
In such a case it may be assumed that it would cost something like £2,000 to cut into the E.H.T. lines for a supply of low-tension energy. Existing data shows that the average consumption of current in an agricultural district with a population of 22,500 is 58 units per head, so that taking the county of Hereford as a whole, with a population of 114,296, the possible sale of energy on the same basis would amount to, say, 6,637,000 units. This supply would be given in an area 40 miles long by 35 miles wide, with a central distributing point. Throughout England, towns of any size of over 20,000 population are 25 to 30 miles apart, with smaller towns of up to 10,000 people between; this is the case in all the agricultural areas, and the distribution lines from most E.H.T. transformer stations would thus extend to about 15 miles radius. It will be seen that the estimated output of 6,637,000 units, at an average price of 3d. per unit, would represent a revenue of £82,962, or, taking as a basis the number of farms in the county—3,573 of an average of 150 acres—and allowing the same yearly revenue as already obtained from farms connected to the Hereford City supply, viz., £25, we obtain a revenue of £89,325 from farms alone. If the farms did not all elect to use electricity, there would still remain numerous country houses and rural industries as available consumers, as well as village water supply and electric lighting installations. It is probable that the estimated consumption given would be exceeded.

As a matter of comparison, it may be pointed out that the South Metropolitan Electric Supply Company, during the year, had an output of 6,695,481 units sold, at an average price of 2·22d. per unit, and resulting in a total revenue of £62,068. In this case the underground mains and distributing system would be a great deal more expensive in capital cost, and it would be much easier to sell the current in the rural districts where there is no competition in the form of gas supply and better railway facilities for coal and oil for generating power.

There are many other directions in which electricity is making headway in connection with agriculture which should not be overlooked, and the foremost of these is "Electro-Culture." Experiments that have already been carried out have given most favourable results, notably those of Mr. J. S. Newman, of Bristol, and Miss Dudgeon, of Lincluden, Dumfries. These were described by Sir Oliver Lodge in the Kelvin Lecture on "The Electrification of the Atmosphere," in March, 1914. Miss Dudgeon is still carrying on her experiments, the current supply being obtained from a 30-volt storage battery used with a spark coil and rectifying vacuum valves; these are, however, expensive instruments and quite out of the question for an ordinary farmer, besides requiring a certain amount of expert knowledge to get the best results. If a high-tension alternating supply were available, a small transformer with valves for rectifying, and an automatic time-switch for controlling would be less costly.

In 1915, Miss Dudgeon obtained an increase of over one ton per acre in the yield of potatoes, due to the electric treatment, and, in the case of oats, an improvement of 31 per cent. in grain, and 63 per cent. in straw.

The remainder of the Paper deals with electric chicken incubators, the use of electric light for increasing the appetites of sheep, &c.



Curve of Daily Output at Hereford.

Discussion.

Councillor LANGFORD (Hereford), whose farm has been equipped by Mr. Kerr, said he was driving a milking machine for milking about 70 or 80 cows, and a chaff-cutter; he also pulped the roots of mangolds and swedes, crushed the cake necessary for feeding the animals, and had a small motor for the purpose of pumping water from a deep well, whilst during the season that had just passed Mr. Kerr had adapted for him some sheep-shearing apparatus in conjunction with a portable motor. In addition, he was lighting the whole of the farm buildings, and, further, was crushing apples and pressing the juice from them for cider-making, as well as filtering the cider. Before he adopted electricity for filtering he used to have to draw the cider from various long distances in the cellars in the yards to the fixed engine before it could be put through the filter. Now, however, he was able to take the portable pump and motor wherever he required it for filtering the cider. He was perfectly satisfied with what he was now getting from electricity, but he wanted something more. He wished to plough the land and till it, mow the grass, reap the corn, and haul it home by motor, and, what perhaps was more important, he wished to snap his fingers at a dry season and take the motor down to the riverside and irrigate the land. If the war had not broken out Mr. Kerr had intended to fix up an apparatus with which some severe tests on electro-culture would have been carried out. He was exceedingly glad for many reasons to be rid of the steam and oil engines he used to employ.

Mr. F. AYTON (Chief Electrical Engineer, Ipswich) did not think that a battery-driven plough, as suggested in the Paper, would be successful, for the reason that in ploughing the land the amount of power required for turning over the land varied immensely with its nature, and with very heavy land such a large amount of power might be required that the battery would have to be of a size quite out of proportion to what would be suitable for carrying about the farm. The Paper, again, raised the question of wayleaves, and he was afraid not very much would be done in the way of supply to rural areas until more reasonable legislation was passed in regard to this matter. The Association might do some good by again pressing the Board of Agriculture in this connection, because there was a better reason now, having regard to the Board of Trade circular relating to linking up. Those stations which at present generated continuous current, however, could not hope to do very much in the way of getting agricultural supply unless they changed to alternating-current supply. From experience he could say that it was quite easy for every continuous-current station to tack on, so to speak, a three-phase high-tension supply. He had done so, and had found the use of the inverted rotary converter with automatic voltage regulation quite satisfactory. Another essential for the development of the agricultural load was to educate the farmer to a knowledge of the advantages of electricity.

Councillor DYMOND (Hereford) said that, so far as Hereford was concerned, it was not necessary to educate the agricultural population, because they simply came to the Department and howled for current. On the question of whether it was worth while to take this load up, it was necessary to make some comparison of the agricultural consumer with the ordinary consumer. In Hereford, by leaving out four large consumers, there were 983 ordinary consumers, bringing in, on the average, £5 12s. per annum. On the other hand, 19 agricultural consumers brought in about £25 each per annum, so that as far as that was concerned the load was well worth cultivating.

The difficulty of extensions in Hereford was wayleaves, and these difficulties at times were so great that it almost made one drop the business. He suggested that all electrical undertakings should get into touch with their local agricultural societies, which existed practically all over the country, and get them to pass resolutions in favour of a supply of electricity in bulk being more easily obtained, and to send these resolutions to the Board of Agriculture, and from the Board of Agriculture to the Board of Trade. Then there might be some reasonable chance of getting the very antiquated and absurd regulations regarding wayleaves removed. He suggested, also, that careful consideration should be given to the question of the price charged to the farmer from the point of view of the value the current had for the purpose in hand. Whereas in 99 cases out of 100 an ordinary consumer took energy merely because it was convenient or cheap, or perhaps both, in the case of the farmer electricity was *the* form of energy and the only form which would do the job, and the financial result to the farmer was out of all proportion to the cost he paid for the current. In the case of potatoes, for instance, which before the war produced between £3 10s. and £4 per ton, it had been proved conclusively that about a kilowatt of demand would deal with 50 acres, and that 23 additional hundredweights per acre could be obtained. This at the ordinary prices would give approximately an additional profit of £200 for an expenditure of about 28 units per week for three or four months, a ridiculously small expenditure of current. If electrical engineers were going to produce for the agriculturists of the country these extra profits, they were entitled to a little more than 15s., 16s., or £1 in current even at the maximum rate of 8d. per unit, and therefore he argued that some steps should be taken to make the charge proportionate to the result produced. There ought to be legal power to do this, although, at the same time, the electrical undertaking could be trusted not to make such a charge as would in any way kill the business.

Mr. W. B. WOODHOUSE (Yorkshire Electric Power Company) said one advantage to the farmer not mentioned by Councillor Langford was the considerable reduction of fire risk. From the supply undertaking point of view, of course, wayleaves were the real difficulty, and he was glad that so many speakers had suggested that the Association should deal with this matter. It could be dealt with much more effectively when the farmer had been persuaded that it was necessary that he should have electric power. There were a great many small farms in Yorkshire using electricity, and they were connected in some cases to the 10,000-volt overhead lines by means of a pole transformer.

Mr. S. E. BRITTON (Chief Electrical Engineer, Chester) referred to a farm of 500 acres to which he had supplied electricity for eighteen months upon which there were 200 head of cattle and 300 sheep. The original equipment was a steam engine, which supplied power for corn crushing, cutting wood, &c., and the cost per annum, including the necessary repairs, was £33. Since the farm had been equipped electrically the total cost was £23 per annum at a penny per unit, and the farmer was delighted with the results.

Mr. W. C. BEXON (Chief Electrical Engineer, Kilmarnock) referred to a sixty-light installation, in addition to a 12 horsepower motor, on a farm connected up to his mains, the annual revenue from which was between £15 and £19. The reason why this particular farm was connected up was due to the difficulties in obtaining wayleaves for carrying the transmission wires further on, and it was found that the only way to get this permission was to equip the farm for the farmer. He adopted the same arrangement as Mr. Woodhouse, namely, a pole transformer, and the farmer had found the working costs to be much cheaper than oil, particularly now that labour was very short. Altogether he had five farms which were working electrically.

The annual meeting was held on Friday morning.

Council's Report.

The twenty-first Annual Report of the Council shows that the membership stands at 377, the same as last year.

Model General Conditions of Contract.—The British Electrical and Allied Manufacturers' Association have expressed the hope that the Incorporated Municipal Electrical Association would now recognise the Institution of Electrical Engineers' conditions as standard. The Council have, however, been unable to take any further steps in the matter pending the receipt of the Report of the Association of Municipal Corporations.

I.M.E.A. Bill.—At the suggestion of the British Electrical and Allied Manufacturers' Association, joint meetings of representatives of the Incorporated Municipal Electrical Association, the British Electrical and Allied Manufacturers Association, and the Electrical Contractors Association have been held, at which it was believed that a complete settlement agreeable to all parties had been arrived at. After reference to the full Councils of the respective Associations, however, the Electrical Contractors Association finally declined to continue negotiations and decided to oppose the Bill so long as powers to sell are retained therein. [The Presidential Address refers to this matter in greater detail.]

Engineering Standards Committee.—At the last Annual Meeting an appeal was made to representatives of the Committees present to contribute more liberally to the funds of the Engineering Standards Committee, and shortly afterwards the Association issued an appeal to its members, the result of which was a substantial addition to the subscriptions from municipalities to that Committee. The Association also renewed its donation of £21.

Eastbourne Accident and the Board of Trade.—The Council have had under consideration the Report of the Electrical Adviser to the Board of Trade on the subject of the fatal accident which occurred on Dec. 26th last, arising out of the collision of a motor-car with a switch pillar (ELECTRICAL ENGINEERING, Feb. 10th, p. 48). At the request of the Eastbourne Electricity Committee, the Council received Mr. Fovargue, the Town Clerk, and Mr. Brydges, the Electrical Engineer, who, after laying before the Council certain information with regard to the matter, expressed a desire that the Council should approach the Board of Trade with a view to getting the recommendations contained in the above-mentioned Report modified. The question is still engaging the attention of the Council.

Coal Supplies.—On the invitation of the Institution of Electrical Engineers, the Association appointed a representative to attend a National Conference of representatives of the gas and electrical industries for the purpose of considering the question of coal supplies at the Institution building on May 6th, 1915. Mr. Chattock represented the Association at this conference, which was attended by a large number of engineers and committee representatives of municipal electricity supply undertakings from all parts of the country. As a result, a deputation of 34 representatives was appointed to present the case to Members of Parliament, asking for their assistance in urging the Government to give effect to the recommendations passed at the meeting calling for increased output, railway transit facilities, and proper regard to the requirements of public utility undertakings dependent upon their supplies on sea-borne coal when requisitioning coal steamers. Subsequently, the whole question of coal supply as affecting members of the Association was referred to a sub-committee with instructions to make recommendations and to assist members in any difficulty with advice as to proper procedure.

Since the District Committees appointed by the Board of Trade have got to work it has become evident that they have very little power to obtain coal for public utility undertakings; and this appears to be due to the fact that there are no legal powers for this conferred upon the Board of Trade. Steps have therefore been taken to urge upon the Government the desirability of giving the Board of Trade powers to distribute coal where it is required, and to organise local coal for local use as far as possible, and so relieve congestion on the railways. It was also urged that more steamers should be provided to bring coal down from the North to the South of England. The sub-committee is continuing its work and dealing with inquiries from members.

The Council.—The Council have had under consideration a communication from Mr. Purse, of Carlisle, making observations on the constitution of the Council and some suggestions having for their object more particularly a definite representation of the smaller undertakings on the Council, and the substitution of a postal ballot for the present procedure, whereby the ballot is restricted to those members attending the Annual Meeting. On the invitation of the Council, a deputation representing some of the smaller undertakings attended a meeting and placed their views personally before the Council. The Council are of opinion that it would be unfortunate to draw any distinctions between members as representing the large or small undertakings or otherwise, and believe that satisfactory representation is gained under the existing Articles of Association.

Institution of Electrical Engineers' Wiring Rules.—The Institution Wiring Rules Committee, on which the Association has two representatives, have again revised the Rules and invited the Council of the Association to give their adhesion thereto. This the Council have done, but with the recommendation that the Rules should be rearranged, so as to distinguish Regulations from Recommendations. At the same time, the Council made suggestions or amendments for further revision.

British Trade after the War.—The Council have had before them the Report of the sub-Committee of the Advisory Committee of the Board of Trade on Commercial Intelligence with respect to measures for securing the position, after the war, of certain branches of British industry, and after having given the Report careful consideration unanimously passed the following resolution :—

"That this Council, while being anxious in every way to encourage British trade and the purchase of home manufactures, and being prepared heartily to support measures taken to this end by legislation or otherwise, view with deep concern Recommendation 6 (*b*) of the Sub-Committee of the Advisory Committee of the Board of Trade to the effect that :

"'All Government Departments, Local Authorities, and Statutory Bodies entrusted with the control of monies raised by taxes or rates should be under legal obligation to purchase, so far as possible, only goods produced within the British Empire.'

"The Council is strongly of the opinion that in the event of this Recommendation being adopted, the interests of Municipal Electrical Undertakings and their consumers—which latter embrace some of the largest manufacturing concerns in the country—will be seriously jeopardised, and that Municipalities should in no way be subjected to any restrictions with regard to the purchase of plant and materials other than those imposed on private concerns."

Honorary Treasurer's Report.—There is a surplus for the year of £77, as against £62 last year

Development Committee.—Owing to circumstances caused by the war, the Development Committee have for the time being suspended their activities.

Electric Vehicle Committee.—The report of the Committee is given below.

Financial Organisation.—As a result of the Council having received a number of communications from engineer members intimating that difficulties were being experienced by them in efficiently managing the undertakings for which they are responsible, by reason of the systems of financial control adopted by the Local Authorities owning such undertakings, it was decided that the matter was of such importance as to warrant the appointment of a Special Sub-Committee to consider the whole question and to report thereon. The Sub-Committee, after deliberating upon certain evidence which was put before them, came to the conclusion that the difficulties experienced were not peculiar to electricity supply undertakings, but were common to all municipally-owned trading departments, and that the matter could better be dealt with by a Joint Committee composed of members of various interests concerned. To this end, the co-operation of the Municipal Tramways Association, the Municipal Waterworks Association, and the Institution of Gas Engineers was invited, with the result that these bodies have appointed representatives to serve on a Joint Committee, and meetings of the Committee so formed are being held.

Members are asked to forward to Mr. Wyld (Hampstead), the Hon. Sec., particulars of troubles which are being experienced by them in connection with this matter.

The somewhat brief statements on matters of importance, such as the I.M.E.A. Bill, &c., convey little idea of the amount of work done by the members of the various committees and sub-committees, who have been called upon to give a great deal of time to the consideration of questions referred to them. The Council and the Association are particularly indebted to the Hon. Secretary, Mr. H. Faraday Proctor, for the manner in which he discharges the duties devolving upon him.

Discussion.

Model General Conditions.—Mr. R. A. Chattock (Birmingham) proposed that the Association should now adopt the Model General Conditions of contract issued by the Institution of Electrical Engineers. He referred to the special meetings held two years ago, at which the institution was instructed to communicate with the Association of Municipal Corporations with a view to the Legal Committee of that body expressing an opinion upon certain of the clauses which a large number of municipal electrical engineers objected to on the ground that, at any rate so far as the small undertakings are concerned, it placed them too much at the mercy of the manufacturers of electrical plant. These clauses have come to be known as the four B.E.A.M.A. clauses, and relate principally to terms of payment and conditions of taking over. Mr. Chattock said he saw no danger in accepting the conditions, at any rate provisionally, and giving them a trial for a year or two, incidentally mentioning that no reply had yet been received from the Association of Municipal Corporations.

Mr. H. Faraday Proctor seconded the proposal.

Mr. A. S. Blackman (Sunderland), as one of the movers in the agitation against the adoption of the Model General Conditions two years ago, said whilst nothing had happened to make him change his opinion during the past two years, possible events arising out of the war had strengthened him in the view that the small municipalities would in future be in an even worse position as regards their position with the manufacturers after the war if they had accepted the conditions as they stood, and he was quite unable to fall in with the suggestion made by Mr. Chattock.

Mr. C. C. Atchison (Rochdale), Mr. F. W. Purse (Carlisle), Mr. Nichols Moore (Newport, Mon.), Mr. T. Roles (Bradford), and Mr. J. A. Robertson (Salford) all strongly opposed the resolution, and eventually it was withdrawn pending a reply from the Association of Municipal Corporations, who, Mr. Atchison mentioned, had just recently passed the final draft of the revised conditions, information which had come to his knowledge through the Town Clerk of Rochdale being on the sub-committee of the Law Committee of the Association of Municipal Corporations, which is dealing with the matter.

The President, however, remarked, and in this he was supported by the Hon. Secretary, that no communication had been received by the Incorporated Municipal Electrical Association from the Association of Municipal Corporations for a very long time, and they knew nothing of what Mr. Atchison had mentioned.

Constitution of the Council.—A long discussion took place, on the initiation of Mr. F. W. Purse (Carlisle), with regard to the constitution of the Council. His point was, and he received a considerable amount of support, that the Council as at present constituted contains too large a proportion of representatives of large undertakings, notwithstanding that the large undertakings as a whole form a minority of the members of the Association, and consequently contribute to a comparatively small extent to the revenue of the Association. In all, he pointed out, there are 238 members of towns with less than five million units per annual output which contribute £250 out of a total of £360 revenue.

It was pointed out by the President that the constitution of the Council is absolutely in the hands of the members, inasmuch as they can nominate whom they please, and eventually it was referred to the Council to give consideration to the matter, although it should be pointed out that a deputation from small undertakings recently had a conference with the Council on the subject.

A resolution, however, was passed in favour of carrying out the election of Officers and Council in future by means of a postal ballot, and for this purpose the necessary alteration in the Articles of Association are being made.

The Industrial Position after the War.—Alderman Walker (Manchester) moved a resolution, which was subsequently carried, urging the Government to take adequate steps to deal with the industrial situation which would arise immediately peace was declared, especially having in view the interdependence of the manufacturing and electric supply industries of the country. Alderman Smith, of Liverpool, suggested that something more effective would be done if municipal electric supply undertakings took steps to protect their own interests without merely asking the Government to take action. In the view that the Association should do its utmost to encourage trade in this country after the war, Alderman Smith was strongly supported by Mr. H. Dickinson, the City Electrical Engineer at Liverpool, his argument being that it is necessary to educate the Government to change its attitude absolutely in the future with regard to trade questions. Councillor Jones, of Kilmarnock, made a strong speech on similar lines, and the resolution was finally passed in the following form :—

"This Convention of the Incorporated Municipal Electrical Association urges the Government to take adequate steps to deal with the industrial situation which will arise immediately peace is declared. The members attending this Convention represent the electricity supply departments of public authorities in which many millions of public money is invested, and the prosperity of these departments is dependent on the prosperity of the manufacturing and commercial sections of the community."

This resolution is to be forwarded to the Board of Trade.

Financial Organisation.—The following resolution was passed on the motion of Mr. W. Wyld (Hampstead) :—

"That this Association views with concern the repeated attempts made by the finance departments of various municipalities to encroach upon the work of the trading departments, and is of opinion that it is necessary that the books and accounts should be kept by the departments concerned if the work is to be efficiently and economically carried out, and that any proposed legislation in a contrary direction should be strenuously opposed."

Place of Meeting in 1917.—The selection of the place of meeting for next year was left to the Council.

Preferential Charging.—Mr. H. Faraday Proctor (Hon. Secretary) referred to a legal action which a gas company has threatened against the Hackney Borough Council for alleged preferential charging. The position was the exact converse of the Long Eaton case; but the Council had gone into the matter and had taken advice, which was to the effect that the position was entirely good from the point of view of Hackney. The allegation was that Hackney was showing preference by their public rates of charging, whereby they allowed lighting consumers a lower charge if they took a power supply as well. In all the Power Company Acts, an authority to give a lighting supply at power rates was given up to a certain percentage of the total supply given, and from Mr. Justice Sargent's summing up of the Long Eaton case it was evident he took the view that there was no illegality on the part of any supply authority doing this. At present the Hackney Council was not aware whether the Gas Company would go on with this threat or not. It seemed exceedingly probable that, having had a better opportunity of looking at the matter, the Gas Company would climb down and nothing more would be heard of it; but the Council had passed a resolution on the matter, and it was felt desirable that the Association should confirm

it, giving Hackney the moral support of the members and, if necessary, financial assistance. He therefore proposed that they should give Hackney support in this matter, and he asked the members, if necessary, to support Hackney financially and with evidence in the event of there being a fight.

The resolution was carried.

Loan Periods and the War.—Mr. C. Turnbull (Chief Electrical Engineer, Tynemouth) proposed the following resolution:—

"That the Council make representations to the proper authority that, on account of conditions arising out of the war, it is desirable that the loan periods for electricity works be extended."

He referred to the fact that Edinburgh had met a loss of £17,000 by raising their loan period from 25 to 30 years. In Scotland, he explained, the ordinary loan period is 30 years, and Edinburgh had previously voluntarily reduced it to 25, but had now reverted to the statutory period, having regard to the effect on the undertaking of the conditions due to the war. The same position was affecting many municipalities in England, and if an increase of five years could be obtained it would in many cases tide undertakings over a period of difficulty.

The resolution was seconded by Mr. W. C. P. Tapper (Stepney).

Mr. F. A. Newington said that the Edinburgh Corporation had only increased their loan period to the statutory 30 years for one year, knowing that they were in a perfectly sound financial position with their reserve fund full, and they would never have asked for powers to extend the loan period as suggested by Mr. Turnbull.

On a show of hands the resolution was declared lost.

Election of Officers and Council.

The following is the result of the ballot for Officers and Members of Council for the year 1916–17:—

President.—F. M. Long (Norwich).

Vice-Presidents.—S. J. Watson (Bury), F. Ayton (Ipswich).

Past-Presidents.—R. A. Chattock (Birmingham), H. Richardson (Dundee), A. C. Cramb (Croydon).

Members of Council.—J. W. Beauchamp (West Ham), A. S. Blackman (Sunderland), S. E. Britton (Chester), W. W. Lackie (Glasgow), S. L. Pearce (Manchester), W. A. Vignoles (Grimsby), S. T. Allen * (Wolverhampton), J. Christie * (Brighton), J. H. Bowden * (Poplar), Councillor H. R. Barge (Poplar), Alderman Sir J. Beecham (St. Helens), Alderman Sinclair * (Swansea), Alderman Walker * (Manchester), Bailie W. B. Smith (Glasgow), Councillor T. Evans (Sheffield).

The names marked with an asterisk are newly elected.

Hon. Member.—The President announced that Mr. A. B. Mountain, of Huddersfield, has been elected Hon. Member on giving up municipal employ.

Report of Electric Vehicle Committee.

The work of the Committee has been reported in our columns during the year (Electrical Engineering, Oct. 14th, p. 419, and Dec. 2nd, p. 485, 1915, and March 2nd, 1916, p. 97). The report does not add much to what has already been published.

The Committee, jointly with representatives of the Tungsten Lamp Association, have considered the question of the sizes of bulbs, and the voltage of incandescent lamps for use on electric vehicles. The result of the joint deliberation was the issuing of a recommendation that, in view of the comparatively small consumption of electric energy by electric vehicle lamps, and the increased reliability of those made for low voltage, the standard voltage should be considered as 12 volts, the lamps to be coupled across a section of six cells in a lead-plate battery or the equivalent number in a nickel-iron-alkali battery. It was recommended that the sizes of bulbs should be those fixed by the British Engineering Standards Committee in their Report, No. 69. The Committee has been in communication with representative electrical engineers in our Colonies with a view to the British Electric Vehicle Standards being adopted throughout the British Empire. Municipalities, electric supply companies, manufacturing firms and others have given financial assistance during this year to the extent of £141.

The Electric Vehicle Association of America has now ceased to exist as a separate body. Its members have been absorbed into the National Electric Light Association of America, which has a membership of about 14,000. The N.E.L.A. has formed an Electric Vehicle Section and the Committee is affiliated with that Section through the membership of the Secretary.

During the past year the following additional bodies have become represented on the Committee:—Garage proprietors; Institution of Municipal and County Engineers; Municipal Tramways Association; Light Railways and Tramways Association: British Electrical Federation, Ltd.

The estimate of electric vehicles in use in the United Kingdom is about 680. This number includes forty-eight electric warehouse or works trucks, the use of which is likely to considerably extend in the near future. It is noteworthy that thirty-three municipalities operate between them, or have on order seventy-eight vehicles. The total number of vehicles quoted above shows an increase during the twelve months of 197 vehicles.

CORRESPONDENCE

EXCESS PROFITS.

To the Editor of Electrical Engineering.

Sir,—I was pleased to see the comments on my article on the matter of "The Excess Profits Tax in Relation to Publicity." A good discussion on such a topic would bring forward a good deal of valuable thought on that and kindred matters.

Briefly, my attitude to the whole matter is as follows: Publicity matters are being neglected to a most serious extent by far too many of our British firms to-day; unless this error of judgment is rectified we shall, as a nation, suffer in the immediate future, owing to our neglect to keep our name and abilities before the world. Then the fact has to be remembered that we have several British electrical companies whose early financial arrangements were very bad. Consequently, we have many companies which have not paid any return on their capital for many years. This failure to pay any dividend has resulted in the managements being altered and the new managements being saddled with the task of putting things straight. In most cases, just before the war, these companies had about made sufficient progress to see the possibility of further healthy development. Then came the war, and whilst no doubt some of their extra profits are due to war work, yet much of these profits would have accrued had war not broken out. Hence the heavy spade-work of five and even ten years is in danger of coming under the excess profits tax. As it is these firms who are generally the first to reduce their publicity expenditure, the writer sought to call attention to the matter, in the hope that some discussion might result in action which would relieve these firms to some extent. Naturally, the writer would not think of applying the same idea to firms which had prospered regularly; this, as pointed out in the comments in your current issue, would be an unpatriotic and immoral proceeding. On the other hand, it should be possible to find some method by which the type of firm mentioned could find relief from the very heavy demands made on them, just as they see a chance of turning the corner.

This item is of importance to the sound and regularly-paying firms, as well as to the firms which are being practically re-established. A well-established competitor is loth to take work at a price at which there is no profit; he would sooner pass the contract. Firms which are not so well established must have work at any price, and consequently lower the price of every tender which comes out. On these grounds alone it would pay the whole electrical industry if some relief as outlined could be obtained.

Yours faithfully,

June 24th. The Writer of the Article.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

Speaking at the opening of the new head office of the London District Post Office Engineering Department, London Bridge, last week, Mr. J. A. Pease, the Postmaster-General, stated that of the 5,541 members of the London engineering district staff, 2,132 had joined the colours, 58 had fallen in the war, 68 had been invalided out of the army, 7 had received the D.C.M., and many others had been mentioned in despatches.

In connection with an application for sanction to borrow £4,000 by the Hull Corporation Telephone Committee, the Local Government Board has informed the Committee that it is undesirable to do this in present circumstances. It is explained, however, that the sum in question is in respect of capital expenditure already incurred by the Post Office before the Corporation took over the telephone system. Meanwhile the amount is to be paid out of reserve, but the Local Government Board is to be communicated with again on the matter.

Tramways & Light Railways Association.—The annual meeting will be held at Westminster Palace Hotel to-morrow (Friday), June 30th, at 2.30 p.m. A Paper will be read on "Tramway Transit and Comfort: a Plea for the Passenger," by Mr. T. Robson, after which there will be an inspection of the London General Omnibus Co.'s training school at Westminster. The annual dinner will be held at the Trocadero at 7.30 p.m.

Electrical Trades Benevolent Institution.—An alteration has been made in the rules regarding the position of members who have not paid their subscriptions. The effect is to make it less drastic than formerly. Hitherto, members whose subscriptions are in arrears have not been entitled to any privileges whatever, but under the altered rule a member in this position is not entitled to vote.

Laying 20,000-volt Cables across the Clyde.—By an unfortunate printers' error, the footlines to the two illustrations of this article in our last issue were interchanged.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published June 22nd, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

8,004/15. **Insulating Material.** H. B. MACFARLAND and R. JAY. This material is produced by cooking certain marine plants, such as "eel grass," in an alkaline solution, removing the soluble substance, converting the fibrous residue into a gummy substance by treatment with an acid, and mixing with vegetable fibres from plants of the same species.

8,106/15. **Protective Apparatus.** F. E. BERRY. A protective system for A.C. apparatus employing a protective winding arranged in inductive relationship to a portion of the winding to be protected, and having all or some of its turns connected across it. This protecting winding is designed to fail upon the occurrence of a disturbance in preference to the apparatus with which it is associated. (Four figures.)

11,473/15. **A.C. Motors.** B.T.-H. Co. (*G.E. Co.*) An induction motor designed to secure relatively high impedance at or near the standstill and relatively low impedance at running speed with deep rotor slots containing conductors of much less thickness than the slots arranged between strips of magnetic material. (Four figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: SMITHSON and CALLENDER'S CABLE & CONSTRUCTION Co. [Cable drums] 16,692/15.

Dynamos, Motors, and Transformers: HEYS (*Neuland Magnetos, Ltd.*) [Magneto-electric generating system] 8,227/15; NEULAND [Dynamos] 8,572/15.

Heating and Cooking: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Electric welding, brazing, and soldering] 8,326/15; MARKS (*Landers, Frary & Clark*) [Electric heaters] 8,512/15; BERRY [Heating and resistance devices] 8,829/15.

Ignition: SOC. INDUSTRIELLE DE DELLE [Sparking plugs] 3,439/15.

Instruments and Meters: HEURTLEY [Moving coil instruments] 8,235/15.

Switchgear, Fuses and Fittings: CROCKATT [Lamp lock and shade carrier] 9,993/15.

Telephony and Telegraphy: MARCONI'S WIRELESS TELEGRAPH Co. and WRIGHT [Wireless receivers] 8,927/15; B.T.-H. Co. [Wireless apparatus] 9,720/15; STERLING TELEPHONE & ELECTRIC Co. and WARD MILLER [Crystal detectors] 10,769/15; SIEMENS & HALSKE A.G. [Automatic selectors] 17,946/15.

Miscellaneous: WARREN and WARREN CLOCK Co. [Electric clocks] 8,739/15; JOHN DAVIS & SON and DAVIS [Mine signalling] 13,928/15; JAMES [Electro-dynamic brakes for printing machines] 16,671/15.

The following Specification is open to Inspection at the Patent Office before Acceptance, but is not yet published for sale.

Telegraphy: F. PALMER [Telegraph key] 7,334/16 (*100,590*).

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

14,732/15. **Magneto Ignition.** T. B. MURRAY and N. O. FULTON. A form of flywheel magneto with fixed armature of large diameter and external rotating field magnets.

14,774/15. **Planing-machine Drive.** VICKERS, SONS & MAXIM, A. D. WILLIAMSON, and C. L. SUMPNER. A system of driving planing machines and other reciprocating tools in which the quick return is obtained by speeding up the motor without alteration of the gear ratio, the switchgear being controlled automatically by the movement of the machine.

14,790/15. **D.C. Motors.** JOHNSON-LUNDELL ELECTRIC TRACTION Co. Armatures with two windings specially arranged to equalise the E.M.F. and load, and connected in parallel or to separate commutators.

14,851/15. **Electric Automobiles.** C. LOHNER and F. PORSCHE. Controller giving 14 speeds.

The following are the more important Patents that have become void through non-payment of renewal fees.

Electrometallurgy and Electrochemistry: A. PETERSSON [Electric furnaces] 5,655 and 6/07.

Heating and Cooking: G. G. BELL and J. ST. V. PLETTS [Electric heater with thermal storage] 5,777/09.

Incandescent Lamps: B.T.-H. Co. (*G.E.Co., U.S.A.*) [Metal filaments] 5,575/09.

Switchgear, Fuses, and Fittings: J. W. EWART [Bases for mounting fittings with insulating centre] 5,664/04; A. P., G. C., and P. A. LUNDBERG [Switch insulation] 5,099/08.

Telephony and Telegraphy: F. W. MEDHURST [Portable telegraph and telephone apparatus] 5,209/07; H. H. HARRISON and BRITISH INSULATED & HELSBY CABLES, LTD. [Simultaneous telephony and telegraphy on the same line] 5,137/08.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,500.

A 15-kw. 200-volt generator with connections as shown in Fig. 1, but without any equaliser connection (this being the

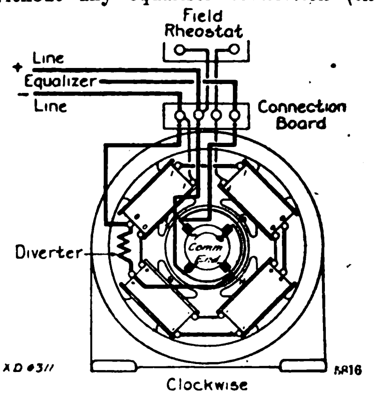


FIG. 1.

only generator), had the armature removed to true up the commutator in a lathe. It was removed from the back end of the machine to save undoing any connections. All dirt was

removed from the armature and the machine generally, and all the winding was varnished. It was noticed that the brushgear insulation was oily, and to remove it one brush-pin at a time was taken out and was put back before another was removed. Not more than one connection was undone at one time to avoid any possible mistake when reconnecting. When the machine was reassembled and the brushes bedded to the commutator surface it would not excite when put to work, but it immediately excited when the brushrocker was moved round 90 degrees. The rocker had not been previously moved. Why is this?—Electrician.

(Replies must be received by first post Thursday, July 6th.)

ANSWERS TO No. 1,498.

I am in charge of the electrical plant at a large works. The current is supplied to us at 6,700 volts 3-phase, through an over-head line, from a step-up to a step-down transformer, the star-points of which are not earthed. If an insulator breaks on one of the phases the switch trips out and cuts off the current. The question is, why should the switch trip when only one phase goes to earth?—Pelican.

The first award (10s.) is made to S.A.S. for the following reply :—

It may be reasonably assumed that, at the voltage specified, the overhead line is of no considerable length, so that ordinary capacity currents are negligible in affecting the operation of the switch. Therefore, a partial or total short-circuit appears to be the only possible cause to assign to the tripping of the switch. This may occur in several ways, *i.e.*, (1) failure of insulation caused by (*a*) possible faulty manufacture, or (*b*) arcing ground; (2) discharge of air-gap protective apparatus, (3) previous unrecorded earth on the system. Taking these causes in order :—(1*a*) On the breaking of an insulator on one line, with a consequent earthing of the line, the potential of the other two lines immediately jumps up to the full delta voltage above earth. Though the line should be insulated to operate at the delta voltage it is quite conceivable that there may exist a faulty place in the insulation, due perhaps to a gradual weakening, and this sudden transition from star to delta voltage (or possibly 1·58 times delta voltage, as pointed out by A. G. Ramsey in your issue of June 15) would quite possibly find this out, resulting in a breakdown to earth. There being then two earths on the system, a dead short occurs, and the switch trips out.

(1*b*) An arcing ground may result from the breaking of the line insulator, which would produce dangerous high voltage surges along the line. These, again, may puncture the insulation, even if normally intact, and so constitute a short-circuit.

(2) If the line is protected by air-gap arresters, particularly of the single-gap type, with small or no resistance to earth, a short-circuit may be easily caused. This probability, of course, depends on the gap setting, and if this is sufficiently small, the excessive delta voltage, or possible high frequency surges set up, may break down the gap to earth. Current flows to earth depending in value on the size of earth resistance, the short-circuit is established, and the switch trips out.

(3) If there was no earth detector on the system there may have been an unrecorded earth on one line, which in itself had no ill effect. As soon as a second earth occurred on another phase, however, a heavy short-circuit current flowed with the results stated.

The remedies in all cases are obvious.

The second award (5s.) is made to E. H. for a reply which we have abridged as follows :—

The cause of the trouble experienced by "Pelican" is briefly referred to in the article on "Electrical Disturbances" that appeared in Electrical Engineering for the 15th inst. If the three phases are identical as regards inductance, capacity, insulation, and loading, the star-point remains at earth potential, but if one of the transmission lines becomes earthed, the lines and the transformer windings (particularly if the cores are earthed) of the other two phases act as one plate of a condenser, so that their steady charging currents become 1·73 times the original values. Such currents would be quite insufficient to bring out the switch, since they are generally very small in comparison with the full-load currents. The capacity to earth of the ungrounded phases, and the alteration of their potential relative to earth when the breakdown occurs, makes the problem very similar to that of charging a condenser with an alternating e.m.f. through a resistance and an inductance.

It will be evident that the charging current consists of two components : the first has an amplitude depending only upon the impedance of the circuit and the amplitude of the applied voltage. The initial amplitude of the second component, however, depends mainly upon the instant at which the circuit is closed, and the amplitude of this second component rapidly diminishes until it becomes negligible, and we are left with only the first component, which is the expression for the steady current.

It should be clear that when an unearthed system becomes grounded, a surge or transient current is almost invariably set up, and may under certain conditions attain a sufficiently high value to trip the switch. It is the presence of these surges that is responsible for a breakdown on such systems (*J.I.E.E.*, Vol. 50, p. 165) to be very often accompanied by another breakdown on one of the other phases.

ELECTRIC FIRES

There appears to be at the present time a rapidly increasing demand for electrical appliances for use in the home, and in the case of electric fires there is still plenty of scope for an energetic campaign to promote their wider adoption. The General Electric Co., Ltd. (Queen Victoria Street, E.C.), are

bent on organising such a campaign, and have recently issued a brilliant little showcard measuring 17 in. by 22 in.; we have reproduced it above, but as the original is done in no fewer than eleven colours, an illustration in black and white can give but a faint idea of its attractive and striking appearance.

1st LONDON ENGINEER VOLUNTEERS

Orders for the Week by Lt.-Col. C. B. Clay, V.D., Commanding.

Officer for the Week.—Platoon Commander J. O. Cheadle.

Next for Duty.—Platoon Commander L. C. Hughes-Hallett.

Mon., July 3rd.—Technical for Platoon No. 9, 46 Regency Street, S.W. Squad and Platoon Drill, Platoon No. 10. Signalling Class and Recruits.

Tues., July 4th.—Officers' Instruction Class, 6—7. Recruits, 7—8. Lecture, 7.15, "Constitution and Duties of a Field Company," Coy.-Cmdr. Bentley.

Wed., July 5th.—Platoon Drill, No. 2 Platoon.

Thurs., July 6th.—Platoon Drill, No. 6 Platoon. Recruits, 5.45—7.45. Instructional Class, 5.45.

Fri., July 7th.—Technical for No. 10 Platoon, 46 Regency Street, S.W. Squad and Platoon Drill, No. 9 Platoon.

Sat., July 8th.—Instructional Class, 2.30, Coy.-Cmdr. Fleming.

Sun., July 9th.—Entrenching at Otford. Parade Victoria (S.E. & C. Ry. Booking Office), 8.35 a.m. Uniform, haversacks, water bottles. Midday rations to be carried. Railway vouchers will be provided.

Note.—Unless otherwise indicated, all drills, &c., will take place at Chester House.

War Tribunals.—The Eastbourne Borough Electrical Engineer, Mr. J. K. Brydges, has applied for the exemption of nine men in the electricity department. The application has been adjourned in order that a list may be prepared showing the exact duties of each man and how many men doing similar work in the department have already joined the Colours.—Mr. C. Furness, General Manager of the Blackpool Corporation Tramways, has asked for exemption till the end of the season for twelve motor-men. Mr. Furness has informed his Committee of the impossibility of obtaining suitable men of non-military age, and therefore, for the first time, he had been compelled to apply for temporary exemption of his drivers.

LOCAL NOTES

Burton-on-Trent: *Electricity Accounts.*—The net profit for the year to March 31st, 1916, was £1,938, but of this £520 have been allocated for depreciation of Consols, whilst £1,308 has been spent on transformers, mains and services through inability to obtain the sanction of the Local Government Board to a loan. In addition to this, before arriving at the net profit of £1,938, a sum of £971 has been spent on plant extensions. The balance of £110 is added to renewals fund.

Dundee: *Heavy Increase in Costs.*—The figures for the electricity department last year show considerable alteration all round. Whilst there was an increase of nearly $3\frac{1}{2}$ million units, the total number being sold being $18\frac{1}{2}$ million units and the net income increased by £12,700, there was, on the other hand, an increase of £10,000 in the costs. As a matter of fact, this is almost entirely represented by coal, which increased to the extent of £9,800 more than in the previous twelve months. The final result is a net profit of £400.

Gosport: *Serious Effect of Labour Shortage.*—The Gosport and Alverstoke Electric Light Supply Co. have issued a notice to their consumers expressing the fear that it may be necessary in the near future to restrict, if not entirely cancel, the supply of electricity owing to labour difficulties.

Hull: *£5,000 Less Lighting Revenue.*—The effect of the lighting restrictions upon the Corporation's electricity undertaking last year was to reduce the lighting revenue by £5,000. On the other hand, the increase in the power revenue was no less than £9,517, and the total result is a net balance of £4,247, which is carried to reserve. Notwithstanding the higher costs of coal and other materials, the working expenses for the year were the lowest recorded by the undertaking.

London: *Marylebone: The Extra High Tension Plant.*—Mr. A. H. Seabrook, the Borough Electrical Engineer, reports upon the very satisfactory working of the Oerlikon three-phase plant which was put into operation towards the end of 1913. During the year ending March 31st, 1914, 24 per cent. of the total current generated at the station was supplied from this plant, during the year to March 31st, 1915, 94 per cent. was generated in this way, whilst for the year to March, 1916, this plant generated 96 per cent. of the total current. The reason for this large percentage is that the turbo-generators, although contracted for to work at 3,000 kw. each, actually give 4,200 kw. continuously; on occasion they have worked at 4,500 kw., and they have even done 5,000 kw. as a maximum. The steam consumption figures also during the $2\frac{1}{2}$ years have been at least up to the contracted guarantee, whilst the figures of coal consumption show a saving of £6,534 compared with what would have been the cost had the old plant still been in use. Against this, the capital charges on the new plant is only £3,526, so that the actual net saving that has been effected is £3,008. We described this plant in ELECTRICAL ENGINEERING for December 4th, 1913, p. 675.

Poplar: A 27 per cent. Increase in Output.—The accounts of the electricity undertaking for the year to March 31st show that the number of units sold increased by no less than 4,607,066, or $27\frac{1}{4}$ per cent. On the other hand, whilst the income from the sale of current showed an increase of £15,051, the working expenses increased by £16,225, the gross profit for the year showing an increase of 3 per cent. After meeting capital charged the net profit was £11,920, against £13,935, and after making various small deductions and additions the net balance for the year was £11,814. The linking-up agreement between Poplar and Stepney obviates the necessity for further extensions until the maximum demand has reached 10,000 kilowatts. It is anticipated that this will be reached this winter, and the Committee is advised that it will be necessary to consider in what form further provision shall be made.

Swansea: *A Record Year.*—The profit of nearly £5,000 on the electricity undertaking last year is a record, but whereas in past years sums varying up to £2,200 have been allocated to relief of rates, it has been decided on this occasion to place the whole of the balance to reserve fund.

Walsall: *A £900 Deficit.*—There was a deficit of £900 on the past year's trading of the electricity undertaking. Although the new power-house was to have been completed twelve months ago it is not yet in use, and the deficit is partly accounted for by the fact that the Committee is paying interest and sinking fund charges on captial expenditure on the new works, which is as yet unproductive. The question of increasing the charges may shortly have to be considered.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Aberdeen.—A recent decision of the Corporation not to proceed with the installation of new plant at the power house, has precluded the possibility of securing new plant for the 1916 winter, but Mr. Bell, the electrical engineer, has called attention to the necessity for making some provision for new generating plant before the winter of 1917. He estimates that a 5,000 kw. turbo-alternator, if ordered now, could be delivered next summer, and the cost is put at 18,000. The Corporation has sanctioned the proposal.

APPOINTMENTS AND PERSONAL NOTES

Mr. A. B. Mountain, Borough Electrical Engineer, Huddersfield, who, as we state in connection with our report of the I.M.E.A. meeting, has resigned, is to be retained as consulting engineer at a salary of £300 per annum and expenses.

Mr. J. W. Turner, who has been Mr. Mountain's chief assistant at Huddersfield, has been appointed to succeed him as Borough Electrical Engineer at a salary of £400 per annum.

The Newport Corporation Electricity Department require Junior Engineers-in-charge. (See an advertisement on another page.)

Captain Henry Newton, of the 5th Notts and Derbyshire Regiment (attached Royal Engineers), who has been awarded the D.S.O., is well known in Derby, being a director of the firm of Messrs. Newton Bros., Ltd., engineers, of Derby. He commanded the Ilkeston Company of the 5th Battalion (T.F.), and accompanied them to the front. Whilst there he was responsible for a number of inventions which were used to advantage by his own battalion, and the Brigadier-General, realising their excellence and utility, gave instructions for them to be provided for the brigade.

Second-Lieutenant Walter J. Cridge, 15th Sherwood Foresters, who was recently wounded in the face when in the trenches "somewhere in France," is now at the 4th Northern General Hospital, Lincoln, where he is going on well.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £132 to £138 (last week £135 to £137).

Indian Agency.—A Calcutta firm desires to get in touch with United Kingdom manufacturers of electrical fittings. Further particulars at 73 Basinghall Street, E.C.

Change of Name.—In future the firm of Eckstein, Heap & Co., Ltd., manufacturing electrical engineers, Lancashire switchgear, Caroline Street, Manchester, will be known as Erskine, Heap & Co., Ltd., permission for the change having been obtained from the Board of Trade and the Registrar of Joint Stock Companies.

Advertising Service.—Mr. A. J. Greenly, of 37 & 38, Strand, W.C., informs us that he will in future trade as A. J. Greenly & Co., business and sales advertisers, at the above address. An electrical and mechanical engineer are retained, and the firm has recently secured the services of a well-known advertising man. Increased offices have been taken to accommodate the increased staff.

ELECTRICAL ENGINEERING

The Engineering Journal of the Electrical Industry

With which is Incorporated

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SUMMARY

A Paper by Messrs. W. Sykes and D. Hall, read before the American Institute of Electrical Engineers, deals with the application of electrical driving to reversing rolling mills (p. 256).

A system of mine signalling by means of electric hooters has been described by the inventor, Mr. R. H. Gould, before the South African Institute of Electrical Engineers. It has been designed to replace the bell system, as it dispenses entirely with the necessity for a "make and break" operation on the circuit underground (p. 257).

A second edition of the memorandum by the Chief Inspector of Factories on the regulations with regard to the use of electrical energy in premises under the Factory Acts has been issued. It deals with a number of further points which have arisen in the working of the regulations since the first edition was published in 1910 (p. 258).

A deputation representing electricity and gas undertakings waited on the Board of Trade last Thursday in connection with the difficulties which are being experienced with coal supplies. The Board has promised to co-operate in order to improve the position (p. 258).

It is expected that the Post Office tube railway will be completed in eighteen months. The electrically-operated trains will be worked without drivers on a distant control system (p. 258).

Women are being successfully employed as sub-station attendants in Glasgow, and also for cleaning and simple switchboard duties at the power-house. Several women drivers are on duty on the Glasgow tramways (p. 259).

The Tungsten Lamp Association has introduced a new scheme of discounts based on the quantity of lamps purchased and delivered during twelve months (p. 259).

Our Questions and Answers page this week deals with the question of allowances made in the size of cables for 3-wire distributor mains on account of out-of-balance current (p. 260).

Among the subjects of specifications published by the Patent Office last Thursday are constant voltage dynamos and wireless telephony. A patent for a phase-meter expires this week after a full life of 14 years (p. 261).

Marconi's Wireless Telegraph Co. last year made a profit of £377,818, an improvement of £145,000 over the previous twelve months. This, however, does not take into account four claims of considerable magnitude against the Government (p. 261).

Illustrated articles describe a garage lighting installation and ironclad switch fuses (p. 262).

The Borough Electrical Engineer at Leek has resigned consequent upon a report with regard to the working of the gas-driven plant.—Satisfactory results were obtained last year with the Chester water-power plant.—The Coventry Corporation has decided to introduce a coal clause in respect of all power supply (p. 263).

Two 1,000-k.v.a. static transformers are required at Manchester.—New boiler plant is proposed at Stoke-on-Trent, and twelve months' supply of paper-insulated cable is required at Rochdale (p. 263).

PRESENT AND FUTURE POSITION OF ELECTRICITY SUPPLY IN GREAT BRITAIN

The Council of the Institution of Electrical Engineers appointed on June 8th last a Committee to consider the suggestion made in Mr. E. T. Williams' recent paper, and in the discussion on "The Present Position of Electricity Supply in the United Kingdom." After consultation with the Incorporated Municipal Electrical Association and other similar bodies connected with electricity supply, the Committee will embody their recommendations in a report to the Council.

The chairman of the Committee is Mr. R. A. Chattock, and the other members are Mr. C. P. Sparks (president Institution of Electrical Engineers), Mr. C. H. Merz, Mr. G. W. Partridge, Mr. S. L. Pearce, Mr. T. Roles, and Mr. W. B. Woodhouse.

We reported Mr. Williams' Paper in our issues for April 20th, p. 141, and April 27, p. 149, and in this connection we would refer our readers to the discussion on Mr. Ellis's Paper before the I.M.E.A., given in our issue for June 29, p. 242, and also to the Lancashire and Cheshire linking-up scheme, of which particulars were given on p. 207 of our issue for June 8th.

That the recent Board of Trade circular has had the effect of awakening interest in the possibility of linking-up all over the country was shown by the remarks at the recent I.M.E.A. meeting. In addition to what has been done in London and is being done in Lancashire, a conference has now taken place between the Bradford Corporation and the Shipley Urban District Council to discuss the desirability of inter-connecting the electrical undertakings of the two authorities. After a general discussion, it was decided that the respective electrical engineers should look into the matter and report, after which a further conference will be held. We may mention that for some time the Bradford Corporation power-house and the Yorkshire Electric Power Co.'s station at Thornbury have been linked up.

1st LONDON ENGINEER VOLUNTEERS

Orders for the Week by Lt.-Col. C. B. Clay, V.D., Commanding.

Officer for the Week.—Platoon Commander L. C. Hughes-Hallett.

Next for Duty.—Platoon Commander J. R. G. Williamson.

Appointment.—Platoon Commander A. Gerard to be Instructor of Musketry.

Sat., July 8th.—Instructional Class, 2.30, Company-Commander Fleming.

Mon. July 10th.—Technical for Platoon No. 9, 46 Regency Street, S.W. Squad and Platoon Drill, Platoon No. 10. Signalling Class and Recruits.

Tues., July 11th.—Officers' Instructional Class, 6—7. Recruits, 7—8. Lecture, 7.15, "The System of Command," Company-Commander W. Hyman.

Wed., July 12th.—Platoon Drill for No. 3 Platoon.

Thurs., July 13th.—Platoon Drill, No. 7 Platoon. Recruits, 5.45—7.45. Instructional Class, 5.45.

Fri., July 14th.—Technical for No. 10 Platoon, 46 Regency Street, S.W. Sound and Platoon Drill, No. 9 Platoon.

Sat., July 15th.—Parade, Golder's Green Station, 3.0 sharp. Uniform.

Sun., July 15th.—Entrenching at Otford, Parade Victoria (S.E. & C. Ry. Booking Office), 8.35 a.m. Uniform, haversacks, water-bottles. Midday rations to be carried. Railway vouchers will be provided.

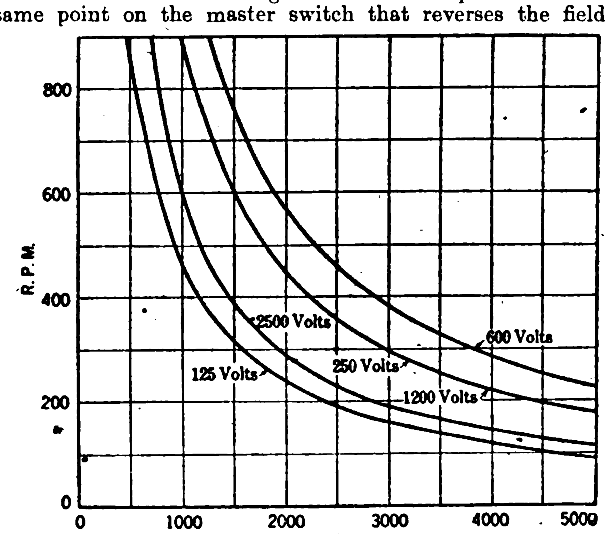
Unless otherwise indicated, all drill, &c., will take place at Chester House.

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

ELECTRICAL DRIVE OF REVERSING ROLLING MILLS

THE application of electrical drive to reversing rolling mills is dealt with in a Paper by Mr. W. Sykes and Mr. D. Hall at the annual convention of the American Institute of Electrical Engineers. The subject is making considerable headway in the United States and Canada, and it is stated that practically all the new installations of reversing mills now contemplated will be electrically driven. Particulars are given in the Paper of some large installations, including a reversing blooming mill of the Steel Co. of Canada at Hamilton, with a double reversing motor developing a maximum of about 10,000 h.p., and that of the Bethlehem Steel Co., with two motors working up to 12,000 h.p. These have direct coupled D.C. mill motors working in conjunction with large flywheel motor generator sets. In recent installations, continue the authors, the reversing motor is arranged to have the characteristics of a compound machine through a series exciter, the voltage of which is proportional to the current flowing in the main circuit. The armature circuit of the series machine supplies a separate winding of the field of the motor, which may be readily reversed when the direction of rotation current is changed. The switches for reversing this field are operated from the same point on the master switch that reverses the field of



the generator. The use of a motor with compound characteristics makes the operation of the mill a good deal easier on the mechanical equipment, as the drive has more or less "give" to it. At the same time, if there is an extreme load due to excessive draft or cold steel, the motor characteristics tend to compensate by automatically increasing the torque available and decreasing the speed.

There are several advantages still claimed by enginebuilders for steam over electric drive for reversing mills. One of these is that the aggregate cost of the electrical gear far exceeds that of the reversing engine, but the authors shew by actual figures that when all steam auxiliaries are included, there is little to choose between the really comparable equipment costs. Again, it is often asserted that the modern reversing engine uses no more steam to do the work required than an electrical drive. A number of comparative figures of steam consumption per ton rolled are, however, given for various classes of material, from which it is calculated that the steam consumption obtainable with up-to-date electrical equipment does not amount to more than 50 to 60 per cent. of that of the best engines yet installed in the United States. Another point is that the more convenient methods of speed control enable a larger proportion of the energy stored during acceleration to be given out at the end of the pass, and the racing of the engine after the metal has left the rolls is avoided. This ease of control also favours economy in time, notwithstanding the large masses to be stopped and accelerated.

There is no other class of service as strenuous as that required of a reversing mill motor, with its heavy torques, sudden peak loads, and quick reversals. Current of as much as 10,000 amperes may be followed by an immediate swing of equal value in the opposite direction, and there must be rapid adjustments of flux conditions in both motors and generators in order to meet these reversals without harmful sparking. For large powers there are considerable advantages in the use of two commutators in series and a relatively high voltage such as 1,200 volts. The peak current is then less and a saving is made in the cost of switchgear, commutators, and brushes, as well as in efficiency. The advantages of keeping the commutators as short as possible will be appreciated by any designer. The authors further go into the limits of size, speed, and voltages for which D.C. machines can be built, giving the curves reproduced in the figure, finally concluding that 600 volts is a desirable selection per commutator for the generators, although 1,200 volts would be possible. 600 volts per commutator has been proved to be well suited to the motor, as a lower voltage would lead to relatively large armature diameter, while a much higher voltage would require few poles with correspondingly heavy rotors, and either of these conditions is undesirable, as low inertia effect is important.

To obtain the best operation under heavy peak loads, which are subject to very rapid changes, for example, three times normal load, reversing at the rate of 30 times a minute, it is not only desirable, but it is necessary to neutralise to the fullest extent the distorting effects of the currents in the armature winding. The method of obtaining this result is to slot the pole face, and secure in these slots a bar winding which is connected in series with the armature, and making a number of conductors in the pole face just sufficient to neutralise the armature conductors covered by the pole face. The excess winding necessary to produce a commutating flux is concentrated on the commutating poles midway between the main poles, and by placing the ampere conductors which neutralise the armature reaction under the pole face, the distortion of the flux at the main pole face is prevented, and this enables heavier overloads to be carried, it reduces leakage flux, and when one considers that the leakage is mainly between the main pole tip and the interpole, and that the magnetomotive force producing this leakage is made very much less by placing a large proportion of the ampere conductors in the main pole face.

This construction, continue the authors, permits the operation of the machines through a wide range of voltage: in other words, the stability of the main flux is insured without regard to the strength of the main field winding. This is an important factor in the general scheme of control, as the speed of the motor and the direction of rotation of the motor depend upon the generator voltage and upon the field strength of the motor. These two factors must be susceptible to rapid changes and wide variations in order to effect the desired result. In referring to the relative merits of commutating pole machines, versus machines with compensating winding, for this class of service, attention may be called to the fact that compensation windings are difficult of construction, in machines having very large current, as there is a limit to the desirable physical dimensions of a single pole face conductor. With heavy current machines, a suitable arrangement of compensating conductors is often quite a problem in a specific design. The most desirable arrangement is to have all compensating conductors connected in series, and the possibility of such an arrangement is limited by the capacity and voltage of the machine, and here again there is a decided advantage in not having the voltage too low, for large power capacities. For example, a single conductor having a cross section of more than two sq. in., is seldom used in the pole face winding. Assuming a current density of 1,500 amperes, a single conductor, with all conductor in series, can be used on a 3,000-ampere machine, which, at 600 volts, represents an 1,800-kw. capacity. For larger current capacities, it is necessary to connect the conductors in parallel, and frequently the circuits are in parallel. In such cases, great care must be exercised in the building of the machines so as to have good joints, in order to

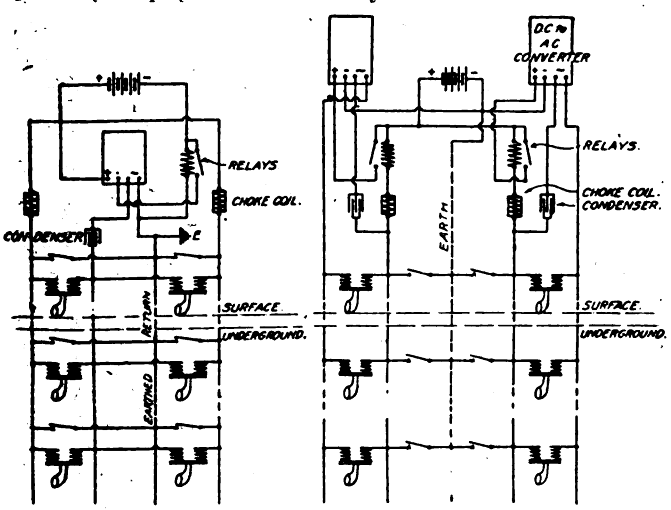
ensure the proper division of the current. Generally speaking, the compensating winding of large capacity machines consists of a relatively small number of conductors, and simpler, better mechanical arrangements can be effected than are possible with smaller capacity machines. It is also desirable to design the compensating winding and the commutating pole winding so that no shunts will be necessary. This can readily be accomplished as it is possible to calculate very closely the required ampere conductors, for compensating the armature reaction and furnishing the necessary excitation for the commutating pole. By avoiding shunts, one is insured of the simultaneous change of current in the compensating winding and the armature winding.

The type of field winding used on roll mill machines should be very simple, and such as not to be easily damaged. If a low voltage is used for excitation of the D.C. generator and D.C. motor field coils, these coils can be made of copper strap winding with a layer of asbestos between turns, and the bare edges exposed to the air. Such coils are almost indestructible by heat. Strap-wound field coils arranged in two or more concentric sections insure a natural and easy ventilation.

As this type of machinery is exposed to mill dust, and as this dust is likely to contain a large percentage of conducting material, it is advisable in the design to embody more liberal creepage distances than are necessary for ordinary service. In order to combat, to a certain extent, the bad effects of dust, the armatures may be given a finish by rolling them in varnish and baking them. This produces an insulating film over all parts, and fills all the pores and small crevices in the insulation, and insures a smooth finish which will shed the dust.

A NEW SYSTEM OF MINE SIGNALLING

THE above is the title of a paper read by Mr. R. H. Gould before the South African Institute of Electrical Engineers, and printed in the current issue of the *Transactions* of the Institute. It describes a system of signalling by means of contactless hooters. The disturbances occurring on signalling systems have generally been attributable, says the author, to the make and break of the bells wearing or otherwise going out of adjustment. It is this weakness inherent in D.C. trembling bells that brought about the use on some mines of the single-stroke bells. Apart from the shortcomings of this bell, the principal reason that it is not more generally employed can be clearly stated to lie in the fact



GOULD'S SYSTEM OF SIGNALLING, USING CONTACTLESS HOOTERS.
(Left hand : one converter for two compartments.
Right hand : one converter for one compartment.)

that the current which a single-stroke bell uses compared with that of a D.C. trembling bell is large, and it is consequently difficult to work a number of single-stroke bells in parallel.

The system described by Mr. Gould is intended to embody the advantages of the single-stroke bell system, inasmuch as the apparatus used for giving a sound has no contacts. On the other hand, it will be apparent that the advantages of the trembling bells have been preserved. As far as underground is concerned, it can be seen from the fig. that the connections are exactly the same as those used at present with trembling bells. Instead of bells, hooters are used constructed on the lines of a telephone receiver. The apparatus consists of a coil, a steel magnet, and a diaphragm.

It can be seen from the diagram that on the surface there is provided a D.C. to A.C. converter, one relay and two choking coils, and a condenser. This outfit is readily mounted on a switchboard, and there are only two vibrating contacts in the whole system, and these are on the surface, and can readily be inspected. Moreover, these contacts when properly set are perfectly sparkless in operation, and they should require less attention and readjustment than the best bell. It is necessary to use a converter, as the hooters employed require an A.C. supply of a periodicity equal to that of the sound waves of the tone desired.

On the left is indicated a system where it is not thought necessary to have a different pitch of sound in each compartment. The choke coils and condenser are employed to keep the path of the D.C. and A.C. currents separate. When any of the contacts are closed the relay is energised and closes the D.C. supply of the battery of about 12 volts, and the A.C. current from the converter passes through the contact which is being made at the pull, and thus energises the hooters which are connected in parallel.

The right-hand arrangement is used when one desires a different sound in each compartment. Where only four wires are available for every two compartments this system may also be applied, if the lead of the cable or any other suitable earthed connection be used for the common contact return. The operation is similar to that of the first arrangement. If the right-hand compartment gives a signal, then the converter belonging to this compartment is energised, and each converter is set to give a different periodicity and thus a different tone on the hooters.

With regard to the contacts, Mr. Gould had designed and manufactured an oil pull which he would advocate using in connection with this system, as it was more reliable than any other type, and required practically no attention even when placed in dirty and wet positions.

Electrical Mining Patents.—The only patent specification dealing particularly with applications of electrical engineering in mines published during June was No. 13,928 of 1915, of John Davis (Derby); Ltd., and W. H. Davis, which describes details of an improved construction of centrifugal contact maker used in connection with mine-shaft signalling gear, to effect the release of the signals according to the rotation of the winding engine.

ELECTRICITY IN WORKSHOPS AND FACTORIES

WE are all more or less familiar with the Home Office Regulations for the generation, transformation, distribution and use of electrical energy in factories coming under the Factory Acts, which were made in December, 1908, in accordance with the report of Mr. James Swinburne, F.R.S., to whom the objections received with regard to the draft regulations, published in August, 1907, had been referred. Following the traditions of all Departmental regulations of this nature, they were severely official in tone, and it was because of the numerous applications received for more detailed information that the Home Secretary instructed the Electrical Inspector of Factories to prepare a memorandum explaining the effect of the regulations and the exemptions in the several classes of works and installations to which they apply. That was a welcome innovation, and a "memorandum" appeared in February, 1910.

We now have received a copy of the second edition, in which Mr. Ram again covers the whole ground, and at the same time brings his explanations up to date by dealing with further points which had arisen since the first edition was published. There is also, in the form of an appendix, a note on low-pressure and medium-pressure switchboards, with special reference to distribution boards and motor-starting panels.

As the memorandum (so-called) runs into 84 octavo pages of close printing, it is quite impossible here to deal with the explanations of the thirty-two regulations in detail. Moreover, it is essential that those whose premises come within the scope of the regulations should possess the complete document, which can be obtained from the Government printers or as usual from the publishers of this Journal for a few pence. Certain it is that the document effects a considerable saving of time, not always a conspicuous feature of Departmental routine, both on the part of inspectors and public. Not only are the regulations explained, but a considerable number of practical recommendations arising out of what experience has shown to be good and bad practice are made, and from this point of view electrical engineers generally, apart from those directly concerned, will find much interesting matter in the memorandum. Special attention is given to Regulation 5, dealing with switches and fuses, and this read in conjunction with the appendix on switchboards already mentioned gives a valuable survey of one detail of electrical installations that has given rise to numerous accidents from time to time. Similarly, portable apparatus, a subject in which Mr. Rain has more or less specialised, and earthing are treated at length. Furthermore, the memorandum acts not only as a guide, but as a warning, for cases of prosecution for non-observance of regulations are quoted.

City and Guilds Institute and the War.—The report of the Council of the City and Guilds of London Institute for the past session gives some indication of the extent to which the Institute is devoting itself to the national cause at the present time. The Roll of Honour of the City and Guilds (Engineering) College past and present students and staff who have joined the Forces now contains 811 names, besides which very important work is being done by the remaining staff in the elucidation of engineering and scientific problems which have arisen both at the Admiralty and at the War Office. At Finsbury Technical College, also, the great majority of second- and third-year students have suspended their studies either to go on active service or to work on munitions. The Principal states that posts could have been found for double the number of certified students on the College lists, and that there is every reason for believing that after the war there will be a general revival of chemical industries in this country and a great demand for trained chemists. Special courses of lectures were given to men of the 2nd London Brigade, R.F.A., while they were quartered opposite the College.

Killed in Action.—We regret to note the following casualties among members of the staff of the County of London Electric Supply Co:—Private H. Beazley, 9th Batt. (Buffs) East Kent; Private T. Hyam, 9th Batt. (Buffs) East Kent; Private R. Reeves, 9th Batt. (Buffs) East Kent; killed in action. Lance-Corpl. E. Capon, 5th Royal Berkshire, wounded March 11th; Chief Petty Officer A. Garden, Royal Navy, died of injuries (North Sea)

Chief Technical Assistants' Association.—A meeting of this Association will be held at the Tavistock Hotel, Covent Garden, on Saturday next, July 8th, at 3 p.m., when a discussion on the effect of the war on electric supply undertakings will be opened by Mr. A. P. MacAlister.

COAL SUPPLIES

A DEPUTATION of representatives of Gas and Electricity Undertakings, consisting of the following gentlemen:—Mr. R. A. Chattock, City Electrical Engineer, Birmingham; and Mr. C. P. Sparks, President of the Institution of Electrical Engineers, representing the electrical industry, and Mr. A. E. Broadberry, President of the Institution of Gas Engineers; Mr. H. E. Jones, President of the Gas Companies' Protection Association; Mr. Alderman Phillips, Chairman of the Salford Corporation Gas Dept.; Mr. D. Milne Watson, Managing Director of the Gas Light & Coke Company; Mr. A. Wilson, Manager and Engineer of the Glasgow Corporation Gas Dept.; representing the gas industry, waited on Mr. Marwood, of the Board of Trade, on June 29, and laid before him the various difficulties which are being encountered at the present moment in regard to coal supplies, and more especially those with regard to the making of new contracts for coal for the next twelve months, both as regards quantities and prices.

The deputation was most courteously received by Mr. Marwood and Mr. Carlill, who, after the various members of the deputation had stated their case, informed them that the Board of Trade were prepared, if approached by Gas, Electricity, or Water Undertakings, to use their influence through the medium of the District Coal Committees which had been established in the various colliery areas to procure the necessary quantities of coal required by the public utility undertakings in question. With regard to prices, it was further stated that if any undertaking which had cause to complain of the prices proposed to be charged for new contracts would bring such cases before the Board of Trade, the Board would be prepared to take steps, if thought necessary, so that the prices charged should be justified by the provisions of the Price of Coal (Limitation) Act.

The difficulties which are being encountered by electricity undertakings were mentioned in the annual report of the Council of the I.M.E.A. (ELECTRICAL ENGINEERING, June 29th, p. 249).

ELECTRIC TRACTION NOTES

According to an answer in the House of Commons last week, the Post Office Tube Railway, for which the contract was placed in October, 1914, is expected to be completed in eighteen months. The electrical interest in the tube is that it will consist of a single tube, 9 ft. in diameter, with two 2 ft. gauge tracks. The trains for carrying the Post Office parcels between Paddington, Mount Pleasant, and Whitechapel will carry no drivers, but will be worked on a distant control system. The line is only part of the complete scheme, which in its final form provides for three others linked up with it.

The Dover Electricity Committee proposes to purchase an electrically hauled tractor for coal cartage purposes at the electricity works at a cost of £500.

Mr. J. J. Lightfoot (Secretarial Dept., County of London Electric Supply Co.) has been gazetted as 2nd-Lieut. Royal Engineers (T.F.) Wireless Section.

Death from Electric Shock.—An inquest was held last week concerning the death of an electrical fitter of South Kensington, who received an electric shock at the Albert Gardens, Kilburn, Sub-station of the London & North-Western Railway Co. recently. It appears that the deceased was at work in one of the cubicles of the switchboard, and when found had apparently fallen against a "live" bar. The voltage was 11,000, and the evidence was to the effect that the deceased had been warned that the section was "alive." The jury returned a verdict of accidental death, the Coroner remarking that it was a clear case of accident.

County of London Co.'s Staff War Bulletin.—No. 3 of the Staff War Bulletin issued by the County of London Electric Supply Co. shows that there are now 74 members of the staff with the colours. The deaths to date number 13, whilst the total number of wounded from the beginning now amounts to 36. Portraits are given of 13 men who have received commissions from the ranks.

Enemy Firms Wound Up.—Messrs. Turner & Burger, electrical accessories merchants, 149 Farringdon Road, E.C., have been prohibited by the Board of Trade from carrying on business after September 29th.

Meter Approved.—The Board of Trade has approved the Westinghouse single-phase meter, Type K, and means for fixing same.

FEMALE SUB-STATION ATTENDANTS

AN interesting and successful experiment is being made in Glasgow, namely, the employment of women as sub-station attendants. Mr. W. W. Lackie, the City Electrical Engineer, has selected sub-stations in residential districts which are closed down before midnight so that the girls should have no nightwork, and two of these are already "manned" only by women. They are rotary converter sub-stations with 500 kw. units. On a recent visit to Glasgow we were taken to one of these sub-stations by Mr. Lackie, and found it in sole charge of a thoroughly competent young woman. One of the two 500 kw. sets was running, and the attendant, while we were in the sub-station, started up the second set, paralleled it, and switched it on to the 'bus bars promptly and deliberately, without hesitation, prompting, or any assistance.

Mr. Lackie is very pleased with the efficiency of women workers for such work as this, and it is to be hoped that other central station engineers and the Home Office will be converted to his views. We were ourselves sceptical as to the expediency of employing women for duties other than clerical in connection with electricity works, but Mr. Lackie has quite convinced us that there is no reason why many kept out of the Army and munition works by electricity supply authorities should not be released and replaced by women. In Glasgow, at any rate, the proper type is to be found.

The women are trained first for three weeks at the Head Office and then sent for a further three weeks to the sub-station before they are considered sufficiently proficient to take charge. The wages are 21s. per week while under training, and 27s. per week on attaining proficiency. They are engaged for a week of 54 hours, but the actual average hours per week is only 51. Nine women are up to the present employed, at four sub-stations in all, and in addition there are three at the Port Dundas power station, taking instrument readings, keeping records, and generally doing the work hitherto done by the fourth engineers.

Fourteen women are also employed as cleaners in sub-stations. Their wages are 27s. per week of 54 hours (forewomen 28s. 3d.), and double time is paid on Sundays. They chiefly do charwomen's work, but are also entrusted with the renewal of instrument charts, &c. No previous training period is given to the cleaners.

Most of the women are between 25 and 30 years of age and 5 ft. 6 in. to 5 ft. 8 in. in height, but no definite age or height limit is imposed.

The cleaners are drawn from the class of respectable working women, preference being given to soldiers' widows and others who have suffered by the war, but the class from which the switchboard attendants are being drawn is rather that of educated business women.

It may be mentioned that in Scotland generally women workers are being employed largely in occupations hitherto considered unsuitable for them. In Glasgow there are not only women tram conductors, but also several women drivers—a Corporation motor-car in which we were taken to visit the electricity works in Glasgow was driven by a lady chauffeur—and at a large (electrical) manufacturing works which we visited recently in Scotland women were employed in the shell-making department on heavy lathes and banding presses with the minimum of male supervision. Owing to trade union restrictions, however, it has not been found possible to extend greatly the field for women machine-hands in the electrical portions of the works.

For sub-station work and simple switchboard work, however, it is evident that women can be thoroughly suitable and efficient, and it is to be hoped that the Home Office will recognise this, and, by making the necessary alterations in their regulations, encourage the engineers and managers of electricity works to make the necessary substitutions as soon as practicable.

T.L.A. DISCOUNT SCHEME

THE Tungsten Lamp Association has prepared a new scheme of discounts, based on the quantity of lamps purchased and delivered during twelve months. Two booklets are being distributed, one of which deals with the scheme from the point of view of the Trade Reseller, and the other from the point of view of the Trade User, and any of our readers will receive copies on application.

As new schemes are always liable to failure because they are not thoroughly understood, these booklets should be of great assistance. As we have said, the scheme is based on the quantity of lamps purchased and delivered during twelve months, and the discounts are regulated in accordance with certain stipulated minimum quantities or equivalent net money values. The money values are introduced to cover half-watt type lamps, which of course are higher in initial cost. The total annual turnover in all makes of Association lamps will therefore regulate the terms at which Wotan, half-watt type, Tantalum, or other lamps can be supplied. The booklets referred to give an example of the method of procedure, and the following remarks are intended to supplement the information there given.

A new customer would commence to buy lamps at 20 per cent., but immediately his total purchases of T.L.A. lamps amount to 500 he would automatically become entitled to buy at 22 per cent. In order to avail himself of these terms he must notify the Secretary of the T.L.A., and in addition he would receive from his supplier, or suppliers, a credit note for the difference between 20 per cent. and 22 per cent. on the original lamps purchased As each succeeding step is reached the increased discount would be obtained by means of the same procedure.

There are of course a number of customers who were graded at a definite figure under the previous arrangement, and they will now receive the terms specified for a quantity of lamps based on their past purchases. This will bring them into the new scheme at approximately the discount to which they are entitled, in accordance with their established turnover, and increased discount will be allowed should they improve on their previous figures.

The terms for the Trade User have been somewhat revised, and if lamps are purchased in quantities of less than 50, a discount of 15 per cent. only is allowed. Providing the lamps are ordered in quantities of 50 and over for delivery at one time, the standard schedule of discounts are applicable.

The scheme is therefore absolutely equitable, and ensures to each Trade Buyer a discount directly in proportion to his turnover. As the discounts increase in a succession of easy steps the scheme should be an incentive to business extension. All invoices will be subject to one discount (*i.e.*, the one corresponding to the minimum quantity taken), plus the usual 2½ per cent. (cash) approved monthly account. This obviates the multiplicity of discounts, which are sometimes confusing, and often cause inconvenience and misunderstanding.

Electric Vehicle Committee.—A meeting of the Electric Vehicle Committee was held in London on June 16th, Mr. A. C. Cramb presiding in the absence of Mr. R. A. Chattock. It was decided to issue an invitation to the Royal Automobile Club of Great Britain to nominate a representative. The R.A.C. had been invited to arrange representation at the inception of the Committee's existence, but at that time had declined. It was decided to inquire from the electric supply undertakings as to whether they could make use of a poster if the Committee had one printed. The matter of a standard insurance policy for electric vehicles was again under discussion. Further consideration was deferred until the next meeting. A sub-committee consisting of Mr. E. S. Shrapnell-Smith, Mr. E. W. Curtis, and the hon. secretary was appointed to draft a letter to the B.O.T. with a view to getting electric commercial vehicles excluded from any declaration that might be made prohibiting the import of foreign-made commercial motor vehicles. The Committee's attention had been drawn to the fact that industrial electric trucks imported into the country are not being provided with the standard charging plug. The Committee is unanimously of the opinion that these trucks ought to be provided with the standard fitting, and the secretary has been instructed to write to the manufacturers to this effect.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,501.

I have recently had to deal with an 80-volt, 100-ampere, 4-pole, C.C. dynamo driven by a petrol motor. The diagram of connections shows the machine connected up as a "short shunt," but it is actually connected as a "long shunt" machine. It is considerably over-compounded, and a shunt field regulator marked "regulation 3 to 5 amperes" is provided. What difference in regulation, efficiency, safety, &c., is there between the two ways of connecting up the shunt winding? Which is the more usual method, and why?—I. W. T. K.

(*Replies must be received not later than first post, Thursday, July 13th.*)

ANSWERS TO No. 1,499.

I have a 3-wire D.C. distributor main, 1,000 yards long, to lay in a residential road with a few shops scattered along same. The maximum total load will be 44 kw., and this will be tapped off in fairly equal amounts along the distributor, so that the *average* load in the distributor will be 22 kw. The consumers' declared voltage is 220 volts, *i.e.*, 440 volts across the outers. I can allow 8 per cent. maximum drop in the main, so that if the total load were well balanced between the outers and the middle wire, a $0·075 \times 0·075 \times 0·035$ sq. in. 3-core cable would do.

What increase on this theoretical size of cable should be allowed on account of out-of-balance in the load, and what out-of-balance is likely to occur on such a distributor?—A. M. J.

The first award (10s.) is made to "Arc" for the following reply:—

It is difficult to estimate the out-of-balance current likely to occur on any distributor without an exact knowledge of the load and of the wiring. Thus the shops may have their early closing on different days; the sitting-rooms and bedrooms of the residential houses may—as is too frequently the case—be wired, the former to one outer, and the latter to the other outer. There are also the questions of the relative positions of the positive and negative services, and the incidence of the consumers' peak loads. With special care, however, the out-of-balance current at maximum load should not exceed 10 per cent. of the current in the outers; and in any case it should not exceed about 20 per cent. of the latter. Assuming the worse figure, we will consider the increase in the size of the cables necessary to restrict the voltage drop to the permissible amount.

The resistance of 1,000 yards of 0·075 sq. in. conductor is $\frac{0·7 \times 10^{-6} \times 36{,}000}{0·075} = ·336$ ohm. With a balanced load of 44 kw., the current in the outers is 100 amperes; and since the load is fairly evenly distributed, the voltage drop along one outer is $\frac{100 \times 0·336}{2} = 16·8$, and the percentage drop is $\frac{16·8}{220} \times 100 = 7·64$. With the same total load, and a 20 per cent. out-of-balance current (the dissymmetry also being assumed to be evenly distributed), the maximum current in the two outers and in the middle wire are 110, 90, and 20 amperes respectively. The voltage drop in the outer carrying the heavier current is $\frac{110 \times 0·336}{2} = 18·5$, and that in the middle wire is $\frac{20 \times 0·672}{2} = 6·7$ volts, making a total drop of 25·2 volts, or a percentage drop of 11·5. In order to limit the maximum drop to 8 per cent., the area of each outer should be increased to $·075 \times \frac{11·5}{8} = 0·108$ sq. in., and that of the middle wire to 0·054 sq. in. Of course, it will be evident that the smaller the estimated out-of-balance current, the less is the increase required in the size of the conductors.

The second award (5s.) is given to "Control" for the following:—

With the theoretical size of cable $·075 \times ·075 \times ·035$ sq. in. the resistance would be ·324 ohms. per 1,000 yds. for each outer, and ·695 ohms per 1,000 yds. for mid-wire. This with the maximum total load of 44 kw. 440 volts, 100 amps., average current 50 amps., would give a drop of 16·0 volts for each outer, and assuming a maximum out-of-balance current of 15 per cent., that is 15 amps, in mid-wire to be dealt with by the balancer, which is what might be expected from a residential district such as that described, then the maximum average out-of-balance current in mid-wire is 7·5 amps., giving a drop of 5·2 volts.

Taking the maximum case with one side of the feeder loaded up to 100 amps., and the other side taking only 85 amps., the out-of-balance of 15 amps. would be dealt with by the mid-wire, and assuming average voltage in feeder of 440, the drop would be 16 volts in outer, plus 5·2 volts in mid-wire $= 21·2$ volts, which is approximately 9·6 per cent., whereas the allowable voltage drop is 8 per cent., or 17·6 volts.

With the proportion of outer cable to mid-wire cable suggested, in order to reduce the voltage drop to that specified, each cable would require to be increased in section $\frac{3·6 \times 100}{17·6} = 20·5$ per cent., giving a cable $·090 \times ·090 \times ·042$. With a given total section of conductors this appears to be the most economical proportion for proposed conditions.

Question 1,498.—"Pelican," who submitted this question, writes to say that a few days after he sent it the underground cable connected to the high-tension overhead line gave out at one of the joint-boxes; it was found that one of the insulators on the overhead line had broken down and set the pole on fire, and after renewing the insulator it was found that the underground cable had given out also. Since the cable has been repaired several insulators at different times have given out, but without tripping the switch. One night, however, the works were again shut down owing to the switch tripping at the supply station. The current was switched on again and all the load put on. When inspecting the line a little later it was found that one of the phases had burned completely in two, and each end was hanging across the guard-wire. The guard-wire was completing the circuit on that phase and carrying 90 amps. at 6,700 volts. Not having sufficient time to repair the line owing to darkness coming on, and being desirous to keep the plant running, "Pelican" decided to run the risk, and he repaired the line the following morning. It would appear then, he says, that the cable broke down at the joint-box owing to the heavy surges and increased voltage set up by the faulty insulators. The pole was burned owing to the insulator bolt not being earthed and moisture causing a leakage and heating up, and the line was afterwards burned in two at the other insulator owing to intermittent static discharges and the arcing of the capacity current to earth. The switch in this case would trip owing to the circuit being broken, and then completed with the load on.

Charges for Electricity.—The various increases in charges for electricity which have been made in different parts of the country by electric supply undertakings consequent on the effect of the Summer Time Act have naturally led to questions being asked in the House of Commons. Mr. Harcourt, speaking on behalf of the Board of Trade, stated last week that the Acts and Orders authorising the supply of electricity contained fixed maximum charges, and that whilst the charges to the public did not exceed these fixed maxima, he had no power to intervene. Similarly, in reply to a suggestion that the Board of Trade should see that the increased charges are not maintained when the Summer Time Act is not in operation, Mr. Harcourt said he could not say exactly what his powers to prevent it were. In reply to subsequent questions, Mr. Harcourt has stated he is not prepared to take steps to have prices reduced, as this would inevitably bring about increased consumption

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published June 29th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

8,572/15. **Dynamos.** A. H. NEULAND. A dynamo for giving constant voltage at varying speeds in which the armature flux is controlled by a variable magnetic shunt in the form of an armature between auxiliary pole-pieces held back by a spring and deflected according to the shunt current. (Four figures.)

9,720/15. **Wireless Telephony.** B.T.-H. Co. (*G.E. Co., U.S.A.*). A wireless telephone system using electron discharge tubes both for the transmitting and receiving apparatus, in which the receiving apparatus is kept permanently connected to the antennæ, while the transmitting apparatus is normally disconnected, but is automatically connected through the action of relays when sound waves fall on it. (One figure.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: DOWNES [Flexible conductors] 10,837/15; CUTHBERT [Cable clamps] 13,441/15.

Instruments and Meters: XENAKY & GILMAN [Meter] 8,850/15.

Storage Batteries: E.P.S. Co. (*in liq.*) and SCHOFIELD [Battery plates] 9,012/15.

Switchgear, Fuses, and Fittings: JUST [Resistance material] 4,080/15; B.T.-H. Co. and MARTIN [Controllers] 8,748/15.

Telephony and Telegraphy: INTERNATIONAL ELECTRIC Co. and LE NOIR [Telephone transmitters] 9,113/15.

Miscellaneous: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Vapour electric devices] 9,960/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Traction: F. J. DECKER [Electric trucks] 8,199/16 (*100,648*).

Miscellaneous: A. SANDRINI [Portable battery] 7,936/16 (*100,643*).

Amendment made

5,224/15. **Machine-tool Drive.** R. McK. ROBERTSON and J. LENNOX. This specification, which describes electrically-worked reversing gear for planing machines, &c., actuated by magnetic clutches, has been amended by way of disclaimer.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

15,095/02. **Instruments.** F. CONRAD. A form of phase difference meter with stationary windings and a movable magnetisable armature.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps, &c.: C. LEWIS (*G.E. Co., U.S.A.*) [Clutch arc lamps] 6,040/04; H. BECK [Inclined carbon lamps] 6,305/04; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Flame carbons] 6,088/06.

Electrometallurgy and Electrochemistry: E. A. ASHCROFT [Electrolysis of fused electrolytes] 5,648/05.

Incandescent Lamps: J. W. HOWELL [Mounting filaments] 5,783/09.

Switchgear: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Controllers] 5,611/08; H. W. LAKE (*Cutler Hammer Mnf. Co.*) [Multiple switch starters] 5,909/09.

Miscellaneous: J. MAIR [Push-button lifts] 5,958/07; C. DAY [Electric propulsion of ships] 6,126/09.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

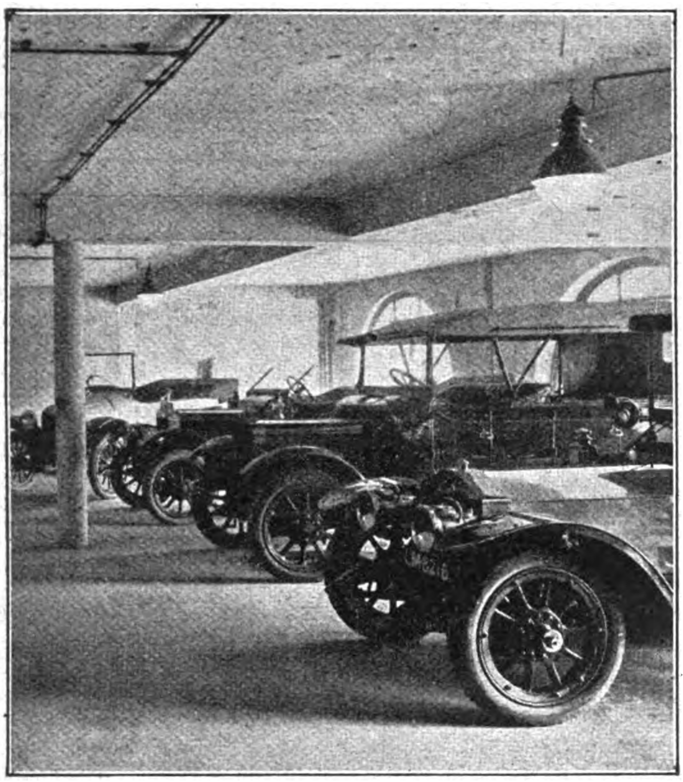
The annual meeting of Marconi's Wireless Telegraph Co. was held in London on Friday, when Mr. Godfrey C. Isaacs, the managing director, made a long and satisfactory statement as to the position of the company. The net profit of £377,818 is an improvement over the preceding year of £145,000, but even this does not include many substantial items not yet settled with the Government. Whilst, on the one hand many of the company's projects in different parts of the world have been hindered by the war, there has, on the other hand, been considerable business done with the Admiralty, War Office, and other Government Departments. The sums in respect of which claims have been made against the Government come under four heads. The first is remuneration and compensation from the Post Office acting on behalf of itself and other Government Departments in respect of the use of the company's higher power stations since the beginning of the war; the second is payment from the Admiralty in respect of the use of patents since the expiration of the agreement on March 31, 1914; there is also a similar claim against the War Office, whilst finally there is a claim against the Post Office in respect of their withdrawal from the contract for the imperial wireless scheme. This latter is by far the most important of all, but negotiations as to a new agreement have not yet brought about a result. The company was informed at the end of 1914 that owing to the altered circumstances resulting from the war the Government had decided not to proceed with the Imperial wireless scheme, and that the amounts disbursed by the company in connection with it would be refunded. In February, 1915, negotiations were entered into for the erection of certain stations on certain conditions, but these were not ratified, and the Postmaster-General expressed his willingness to carry out the original contract for the construction of the Imperial wireless chain. For reasons, however, which were not disclosed at the meeting, the Marconi Company felt itself bound to refuse to do this having regard to the circumstances, and there at present the matter rests, with the company's claim for compensation pending. As to the technical side of the company's business, reference was made to some important improvements and tests by Mr. Marconi affecting both wireless telegraphy and telephony over long and short distances, one of which has resulted in the introduction of a new and simple installation worked from the bridge of a ship, which it is hoped will put an end to all danger of collision at sea in darkness or fog. The total result of Mr. Marconi's recent experiments, said Mr. Godfrey Isaacs, would prove as epoch-making in the progress of the art of wireless telegraphy as was, in 1900, the now world-famous patent known as the "four sevens."

In a scientific paper, No. 269, of the American Bureau of Standards, it is demonstrated that the characteristic linear increase in resistance of radiotelegraphic antennas with increasing wave length (which predominates at the longer wave lengths over the decrease due to decreased radiation) is caused by dielectric absorption in imperfect dielectrics in the electric field of the antenna. It is shown, however, by measurements both at wireless and telephone frequencies that the absorption does not take place in the ground, but in poor dielectrics such as wooden masts, trees, buildings, insulation with poor dielectric properties, &c., in the field of the antenna, the effect being also produced when the leads of an antenna are brought within a building. The practical importance of considering this dielectric absorption in the design of antennas is pointed out in order to increase the efficiency of the antenna as a radiator of electric energy.

GARAGE LIGHTING WITH OSRAM "ATMOS" LAMPS

THE lighting of a large garage presents unusual difficulties, frequently owing to the lowness of the roof in relation to the wide area, which has to be fully and evenly illuminated without glare. Before the days of half-watt lamps the garage illustrated in the accompanying photograph (the Albany Street premises of Messrs. Barningham, Ltd.) was equipped with arc lamps. The change to Osram "Atmos" type lamps has been accompanied by a marked improvement not only in current consumption, but in the volume and distribution of the light.

The lamps, which are rated at 1,500 watts (approximately 3,000 c.p.). are installed in G.E.C. "Third Citizen" lanterns,



Garage Lighted by Osram "Atmos" Lamps.

made by the General Electric Co., Ltd., of London and Witton (Birmingham), with their "Superlux" glass hemispheres. "Superlux" is an opalescent glass which gives an excellent diffusion with a comparatively small loss of light due to absorption. The lanterns used have been specially designed for half-watt type lamps. They are made of green vitreous enamelled iron, and are arranged with triple ventilation. Particular attention has been paid to the shape of the reflector, the curve of which has been designed to give as uniform a distribution of light as possible.

About fifty points were converted in the various showrooms, workshops, and garages of the firm, with results which have proved uniformly excellent.

CATALOGUES, PAMPHLETS, &c., RECEIVED

GLOVER'S ALMANAC.—We have to thank Messrs. W. T. Glover (Trafford Park, Manchester) for sending us a copy of their almanac from June, 1916, to June, 1917. The almanac, as before, is compiled with the idea that much useful information is contained in the technical publications chiefly dealt with which a busy engineer has no time to refer to in the ordinary way. The day by day sheets, therefore, contain interesting extracts on various technical matters, the possible monotony of which is frequently varied by humorous sketches. Glover's almanac is now so familiar to electrical engineers that we need say no more about it.

ELECTRIC FANS.—A new list is issued by The Edison & Swan United Electric Light Co., Ltd. (Ponders End, Middlesex), describing various new forms of electric fans. These include table fans, with solid base containing switch, convertible fans for table or (as brackets) for wall, steamship, and train fans, ceiling fans with unprotected blades, and porthole fans of various kinds. Types are listed for operation with D.C. or A.C., for various standard voltages and frequencies.

MOTORS AND DYNAMOS.—A new pamphlet describing self-contained continuous-current dynamos and motors is issued by Bruce Peebles & Co., Ltd. (Edinburgh). A full specification is given of the machines in question, and the sixteen frame sizes which are listed can be manufactured in any of the usual types —*i.e.*, protected, semi-enclosed, totally-enclosed, mining, or pipe-ventilated types. Illustrations of all these different types will be found in the pamphlet. The first half is taken up with the specification, while in the latter half very complete lists of output ratings are given for the usual standard voltages, and for every size of machine manufactured, separate output ratings being given for each of the five different types enumerated above. There are also given two pages of approximate weights and dimensions.

IRONCLAD SWITCH FUSES

THE use of switch fuses on an extensive scale is a comparatively recent development, and it is interesting to note that manufacturers are just now devoting some special attention to their production. The illustration below shows a switch fuse of the totally enclosed ironclad type made by the British Thomson-Houston Co., Ltd. (Rugby). This one is a triple-pole switch for currents up to 60 amperes, but they are also made double-pole and in 20-ampere sizes, for operation on either D.C. or A.C. circuits up to 700 volts. The fuse-clips and terminals are mounted on porcelain bases, which can be seen fixed in the cast-iron box. Insulating barriers are fitted to prevent any possibility of arcing between poles or between switch and case. It is an excellent point in the design of these switches that all the movable parts are carried by the hinged cover, so that all parts are accessible when the case is open. The switch is so arranged that it can only be left full on or off, and it is locked in either position. The cover cannot be opened until the circuit is broken, consequently no parts of the fuse links and mechanism can be touched until they are isolated from line metal. Protecting shields for the leads, or adapters for screwed conduits, or even sealing chambers for armoured cables, can be fitted to the case if required.

LOCAL NOTES

Barnsley: *Increased Charges.*—A recommendation of the Electricity Committee to advance the charges for lighting current from 4d. to 4½d. per unit, less 5 per cent. discount, and for power by 10 per cent. to 2d. per unit, has been adopted. In justification it is stated that the coal contracts for this year are nearly £2,000 more than last, whilst half the income from public lighting has been lost.

Chester: *Results of Water Power Scheme.*—The water-power plant last year generated 1,567,300 units, and the steam plant 1,900,023. The total number of units sold was 132,458 more than in 1914-15, and the results from the water-power scheme have exceeded anticipations and even the estimates. It was never expected that the plant would generate more than one million units.

Coventry: *Coal Costs and Power Supply.*—The Corporation has adopted a recommendation of the Electric Light Committee, increasing the charges for power supply according to the cost of coal. The scale adopted is that when coal costs the Corporation 13s. 6d. per ton, but is less than 14s. 6d., there should be an increase of 2 per cent. in the charge for power supply, and so on gradually until when the price of coal is 20s. 6d., but does not exceed 21s. 6d., the increase in the charge is 16 per cent. There is no intention at present to increase the charges for lighting.

Hornsey: *Increased Charges.*—There was a deficit on last year's working of the electricity undertaking of £2,789, as against a profit of £38 in the previous twelve months. A recommendation by the Electricity Committee to increase

the charges by a further 15 per cent. has been adopted. The balance to the credit of the net revenue account now stands at £3,985.

Leek: *Difficulties with Gas-Engine Plant.*—Dissatisfaction with the general position of the electricity undertaking led the Electricity Committee to call in Prof. Watkinson, of Liverpool, to report. It will be remembered that some ten years ago the Leek Corporation put down gas-producer-driven plant, and Prof. Watkinson's opinion was asked on the four following questions:—(1) Was it advisable to scrap the present gas-producer plant and replace it by a steam-driven one. (2) Was it desirable to scrap the gas-producer plant, and return to town gas? (3) Should a new and up-to-date producer plant be installed? (4) How could the present plant be most satisfactorily dealt with? In placing Prof. Watkinson's report before the last meeting of the Council, the Chairman of the Electricity Committee said that no one could read it without coming to the conclusion that it was unfortunate the late Electricity Committee had not had expert advice before the existing plant was installed some ten years ago. Prof. Watkinson does not advise a steam plant for a station of the size of Leek, and a return to town gas was not possible because the Campbell engine which works on town gas is a wreck, and the Mather & Platt engine can only work on producer gas. In order to tide over the present difficulty, however, both as to obtaining capital and plant, the Committee has placed the present gas engineer in charge of the gas-producer plant, and reports that satisfactory results are being shown in decreased cost of working. Meanwhile Mr. J. Bemrose, the Chief Electrical Engineer, has resigned, and the Committee recommend that Mr. Ginman be appointed General Manager of the electricity undertaking, with a chief assistant, at a salary of £160 per annum. In addition it is proposed to sell the Campbell gas engine and dynamo at once, and to replace it with a new 200 kw. set.

Llandudno: *Deficit on Electricity Accounts.*—There was a loss of £1,499 on the working of the electricity undertaking last year, the revenue showing a decrease of £957, notwithstanding that an increase in the flat rate for lighting of ½d. per unit last year was estimated to produce an increase of £956. The Electricity Committee proposed to increase the flat rate from 4¾d. to 6d. per unit, the slot meter supply from 5d. to 6¼d., contract supplies from 3¾d. to 4½d., power rate from 2d. to 2½d., and public department supply from 2¾d. to 3½d., but the whole question has been referred back until the agreement with the Electric Tramway Company is examined to see how far it is possible to get a contribution from them towards the increased cost of fuel.

London: *St. Pancras: Revised Charges.*—The Electricity and Public Lighting Committee recommend that the present charge of 1d. per unit for power, heating, and cooking be increased to 1½d. per unit, that the present rate of 20 per cent. allowed for factory lighting be abolished, and that a flat rate of 3d. per unit be charged instead.

Loughborough: *Electricity Accounts.*—A net profit of £302 is shown on the working of the electricity undertaking last year after writing off £59 in respect of free wiring account. The number of units sold was 1,303,341 against 929,051 in 1915, and the total costs, excluding capital charges, were reduced from 0·836d. to 0·774d. per unit.

Nottingham: *Large Increase in Power Supply.*—The annual report of the Electricity Committee shows that whereas there was a decrease in the lighting units last year of 482,979, there was an increase of 877,748 units in the supply for power purposes. The loss of revenue from the decreased lighting supply was £6,736, but the net profit enabled the Committee to transfer £6,677 to reserve, and contribute £5,000 to the relief of rates. The total number of units sold was 13,854,461, an increase of nearly one million units over the previous twelve months.

Stoke-on-Trent: *Electricity Accounts.*—The number of units generated last year was 11,291,932, an increase of 700,000 over the previous twelve months. The net profit on the year's working was £2,169, from which is deducted £986 for meters, leaving £1,183, which is being used towards meeting a loss of £5,413 made three years ago. During the course of the discussion on the accounts at the last meeting of the Council, the opinion was expressed that the four electricity works in the Federated area had now been linked up it was time that the charges throughout the borough were also made uniform. At present the consumers in the four areas are charged on the old basis of the cost of generating at the local stations.

York: *Electricity Accounts.*—There was a net profit of £1,456 on the working of the electricity undertaking in 1915-16.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Manchester.—Two 1,000 k.v.a. Static transformers. Further particulars from the Chief Electrical Engineer, and tenders to Town Clerk by July 10th.

The Guardians require a supply of cable for the Langho Epileptic Colony. Clerk, July 12th.

New Zealand.—Electric lighting plants are to be installed by the Birkenhead and Northcote Councils. An expenditure of £10,000 is contemplated.

Rochdale.—Twelve months' supply of paper insulated cable. Borough Electrical Engineer, July 12th.

Stoke-on-Trent.—A proposal of the Electricity Committee to spend £12,000 upon boiler extensions to enable the working of the standby turbine has been referred back for further consideration. The Electricity Committee originally proposed to spend £33,000 on extensions at the new power-house, but the Local Government Board refused to sanction this. They ultimately sanctioned £12,000, sufficient to carry the undertaking through the present winter. Some dissatisfaction was expressed at the Council meeting, several members not being altogether satisfied that, in view of the refusal of the Local Government Board to sanction the larger scheme, it was really advisable to spend £12,000 at the present moment, and that the savings from the expenditure would meet the necessary capital charges

APPOINTMENTS AND PERSONAL NOTES

Private H. F. Gill, Royal Engineers, Wireless Section (Secretarial Dept., County of London Electric Supply Co.), has been awarded the Military Medal for services in the field.

The Rhondda Tramways Co. appealed last week at the Glamorgan Quarter Sessions against the assessment of their tramways undertaking, and were successful in getting the gross rateable value reduced from £21,500 to £20,500, and the net rateable value from £5,500 to £4,500.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £130 to £133 (last week £132 to £138).

The G.E.C. Cork Branch.—The General Electric Co., Ltd., of London and Witton (Birmingham), &c., advise us that the address of their Cork branch, from whence all orders from the south of Ireland are attended to, has now been altered to No. 76 Grand Parade.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

British Thomson-Houston Co.—There was a trading profit of £276,158 for 1915, which is reduced to £218,236 after providing for interest on debentures and loans. From this the directors recommend the transfer of £144,878 to reserve and depreciation and to carry forward the balance. The amount carried forward includes reserve to cover the sum payable for excess profits tax, which cannot be accurately determined at present.

Companies Struck Off Register.—The names of the following will be struck off the Register of Joint Stock Companies in three months unless cause is shown to the contrary:—British Tungsten Lamp Co., Doncaster Electrical Co., Electrical Advertising Co., Electric Safety Boiler Cleaner, Kevan Electric Co., and Marples, Leach & Co.

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General Electric Co., Ltd , 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Record Electrical Co., Ltd., Caxton House, Westminster. S.W.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
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Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

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Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

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Phœnix Assurance Co., Phœnix House, King William St., E.C.

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Heathman & Co., 10, Parsons Green, S.W.

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British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
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Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
"Lamlok," 18, Ranelagh Gdns., Hammersmith, W.
London & Rugby Engineering Co. Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

MECHANICAL STOKERS.
Underfeed Stoker Co., Ltd., Coventry House, South Place, E.C.

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Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

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Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd., Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
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Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

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British Thomson-Houston Co. Ltd., Rugby.
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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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Matthews & Yates, Ltd., Swinton, Manchester.
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Dermatine Co., Ltd., Neate St., London, S.E.

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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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Willans & Robinson, Ltd., Rugby.

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Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
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Lea-Recorder Co., Ltd., 32, Deansgate, Manchester.
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Jennings & Co., Pennywell Rd., Bristol.

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SUMMARY

THE new edition of "Localisation of Faults," by F. C. Raphael, is reviewed on p. 266.

AT the June meeting of the Diesel Engine Users' Association an interesting Paper on oil and steam-engines in combination was read. The Association is supporting an application to the Board of Trade to suspend a German patent relating to the use of tar oils as fuel (p. 266).

THE Bonecourt system of gas-fired boilers is referred to in an article on page 266.

THE U.S. National Electric Light Association recently held its annual meeting in Chicago. We publish abstracts from the reports of the committees on electrical apparatus and underground construction, both dealing with recent progress. The former deals with the reduction of noise in sub-stations, the starting of heavy machines, three-phase to single-phase conversion, and other matters. The latter is largely devoted to details of conduit construction, cable installation, and cable testing (p. 267).

SOME interesting proposals are to be put before the Government Electrical Trades Committee by the Institution of Electrical Engineers. They include the grant of a Charter to the Institution in order to improve the status and training of engineers (p. 268).

THE City and Guilds Wiring Examinations are discussed in a letter on p. 267.

WE give lists of members of the Institution of Electrical Engineers who have been killed or died on active service, and those who have received military honours, promotions, &c. (p. 268).

WE give some further information as to the manner in which the Summer Time Act is affecting electricity supply undertakings (p. 269).

OUR Questions and Answers page this week discusses the causes of non-excitation of a shunt generator after the temporary removal of the armature (p. 270).

AMONG the subjects of Patent Specifications published at the Patent Office last Thursday were resistance materials, A.C. motors, and flexible cables. A Japanese metal filament patent has been opposed. A patent for resistance material expires this week after a full life of 14 years (p. 271).

WE publish a summary of the recommendations made by the committee on engineering, education, and research of the Council for Organising British Engineering Industry. They are of a somewhat drastic nature, including a reduction in the number of local education authorities, a reform of the system of scholarships, of university teaching, and of the granting of degrees. Closer co-operation between the Government, manufacturing engineers, and education authorities is advocated (p. 271).

WE describe an interesting arrangement of balancing coils in the leads of rotary converters used in conjunction with turbo-alternators for the generation of continuous current, with a view to preventing cross-currents (p. 272).

A NUMBER of further increases in charges for electric supply are notified.—There was a deficit of about £8,000 at Edinburgh last year, whilst at Hampstead it is anticipated that the sum of over £12,000 has to be made up this year.—Good results were experienced at Bradford last year, the net profit being about £16,000 (p. 273).

A TURBO-ALTERNATOR is required in New Zealand, and cables and switchgear at Haslingden (p. 274).

1st LONDON ENGINEER VOLUNTEERS

ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Platoon Commander J. R. G. Williamson.

Next for Duty.—Platoon Commander A. Gerard.

Sat., July 15th.—Parade 3 p.m. sharp, Golder's Green Station. Uniforms.

Mon., July 17th.—Technical for Platoon No. 9, 46 Regency Street, S.W. Squad and Platoon Drill, Platoon No. 10. Signalling Class and Recruits.

Tues., July 18th.—Officers' Instructional Class, 6—7. Recruits, 7—8 Lecture, 7.15, "The Mechanism of the Service Rifle," Lieut. Scott Munro.

Wed., July 19th.—Platoon Drill, No. 1 Platoon.

Thurs., July 20th.—Platoon Drill, No. 5 Platoon. Recruits, 5.45—7.45. Instructional Class, 5.45.

Fri., July 21st.—Technical for No. 10 Platoon, 46 Regency Street, S.W. Squad and Platoon Drill, No. 9 Platoon.

Sat., July 22nd.—Instruction Class, 2.30., Coy. Cdr. Fleming.

Sun., July 23rd.—Entrenching at Otford. Parade Victoria (S.E. & C. Ry. Booking Office). 8.35 a.m. Uniform, haversacks, water bottles. Midday rations to be carried. Railway vouchers will be provided.

Unless otherwise indicated, all drill, &c., will take place at Chester House.

WOUNDED SOLDIERS AS SUB-STATION ATTENDANTS

A COMMITTEE of the Institution of Electrical Engineers, in co-operation with the Education Department of the London County Council, have arranged a four-weeks' course at the Northampton Polytechnic Institute, Clerkenwell, E.C., to enable disabled sailors and soldiers to qualify for training as Sub-Station Attendants.

A first batch of 14 men will complete their course about the third week in July, and successive batches will be available from time to time if it is found that there is a demand for their services. Central station engineers having vacancies in their sub-stations which could be offered to these men are requested to communicate with Dr. R. M. Walmsley, Principal, Northampton Polytechnic Institute, St. John Street, Clerkenwell, London, E.C.

War Tribunals.—The Brighton Military Tribunal has granted final exemption of one month to an electrical wireman, aged nineteen, employed by the Corporation Electricity Department. A previous exemption of three months on account of exceptional family hardship has just expired. No further exemption will be granted, although the man's chief said it would be impossible to replace him.—At the Newcastle Tribunal exemption for three employees of the A.E.G. Electric Co. was applied for by the general manager. The business, of course, is now under the control of the Board of Trade, and it was explained that the company, which is being carried on in the national interests, is composed of British directors with an entirely British staff. The capital, it was said, was provided by Germans some years ago. In consequence of the war three hundred employees have left the firm, a considerable number to join other firms, fifty have gone into our army, whilst some went back to Germany just previously to the outbreak of war. The superintendent engineer was given conditional exemption, another employee was given two months' exemption, whilst the third was ordered to join at once.—A teacher of electrical engineering at the Doncaster Technical Institute, and a member of the Society of Friends, has been granted exemption until Aug. 14th, after which he must find work of national importance.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

The Localisation of Faults in Electric Light and Power Mains. With Chapters on Insulation Testing. By F. C. Raphael. 210 pp. $8\frac{3}{4}$ in. by $5\frac{1}{2}$ in. 128 figures. (London: *The Electrician* Publishing Co., Ltd.) Third edition, revised. 8s. 6d. net; abroad, 9s.

Wherever English is understood, mains engineers will be indebted to Mr. Raphael for the third edition of his well-known book, and especially so from the fact that he has re-written it and brought it up to date during a time of great stress while serving his country. The book gains in attractiveness as it is written in the colloquial language of the cable engineer, and it has the great advantage of having been compiled by one who has had considerable practical experience in cable work, and has kept in close touch with its developments.

The author rightly devotes considerable space to the measurement of insulation resistance, and to the available apparatus, both stationary and portable, because many faults are anticipated by systematic insulation testing. Particular notice is given to the "Megger," which is an invaluable instrument owing to its accuracy and portability. The author might usefully have called attention to its flexibility, as it can be supplied with two-voltage generators, giving, say, 250 and 1,000 volts. It is important also to note that one pole *must* always be earthed to ensure accurate readings.

As most faults occur on low-pressure networks, the author rightly insists that their insulation resistances should be tested frequently during working hours, and, if possible, daily, and he describes four methods of testing continuous-current networks, with examples, and one method each of testing A.C. networks and C.C. feeders.

The insulation testing of high-pressure cables during working hours is briefly discussed in Chapter III., and the three following chapters are devoted to a useful and practical discussion of the loop, fall of potential, and induction localisation methods. Murray's loop method is rightly given pride of place. Some of the most accurate localising I have ever done was carried out with the bridge made of flower-wire strung round tin-tacks on two drum lags, to which the author refers. It is necessary to advise caution and preliminary practice in the use of induction methods. On the first occasion on which I used a coil and telephone to locate a fault on a concentric cable in a cast-iron pipe, I localised it to a street in which no cable was laid! It would be interesting to know whether the Vienna engineers in Fig. 54 still go fault-finding in top hats in 1916? Cannot we have British illustrations next time?

On pages 118-9 the author very rightly emphasises a point which is too commonly overlooked. An A.C. generator should on no account be run-up to speed with a cable connected to it, for the reason given. It is better still to switch the cable on to the machine or transformer at correct frequency, and only afterwards to close the field switch with all resistance in circuit. This gives complete control of the test pressure from zero upwards.

I would suggest to the author that the sequence of the book would be improved by putting Chapter VII. after Chapter X. in the next edition.

Chapter XI., on automatic systems of mains protection, is not very relevant, as these systems only isolate faulty cables, &c., and only "localise" the faults in a special sense. The proofs of formulæ in Chapter XII., and the appendices, are valuable for reference, and round off an altogether admirable mains engineer's *vade mecum*.

B. WELBOURN.

DIESEL ENGINE USERS' ASSOCIATION

THE June meeting of the Diesel Engine Users' Association was held at the Institution of Electrical Engineers during the week the I.M.E.A. held its annual meeting in London, so that several members who perhaps otherwise could not often conveniently come up to town might have an opportunity of attending the Diesel Engine Association's meeting.

Mr. A. J. C. De Renzi (Corporation of Newcastle-under-Lyme) made a suggestion that the Association should hold one meeting in each year in an important centre outside London, such as Manchester, Birmingham, &c., so that engineers in those parts who took an interest in the work of the Association might have the opportunity of attending. The Council is to consider the suggestion.

A motion by Mr. H. Leslie Dixon (Leatherhead), seconded by Mr. C. O. Milton (Maidenhead), that the Association should support the application of the Suffolk Electricity Supply Co., Ltd., to the Board of Trade for the voiding or suspension during the war of the German patent in regard to "Improvements in Internal Combustion Engines," to enable tar oils to be used as fuel, was discussed. It was pointed out that although at present any royalties would be paid to the Public Trustee, the Germans might eventually benefit as a direct result of the war, in consequence of the increased price of crude petroleum oil, which led to the present demand for tar oils as fuel for Diesel engines. Further, on public and patriotic grounds the Association should support any movement which would tend to the preservation and most economical use of the coal reserves of the country. The motion was carried unanimously.

An interesting Paper was read by the President, Mr. Geoffrey Porter, on "Oil Engines and Steam Engines in Combination," in which he discussed the problems met with in extending a comparatively inefficient steam-driven generating station of about 1,500 kw. capacity. We hope to deal with this Paper more fully at a later date, but we may here say that it dealt with the subject from the point of view of capital costs and workng costs, and contained tables showing comparisons of actual results obtained by the introduction of Diesel engine plant at various works.

GAS-FIRED BOILERS

THE remarks with regard to gas-firing of boilers in the discussion on Mr. W. W. Lackie's Paper before the I.M.E.A., and reported in our issue for June 29, give additional interest to a new catalogue which has been issued by the Bonecourt Waste Heat Boiler Co (Parliament Mansions, Victoria Street, S.W.). It is probably known to many of our readers that this system of gas-fired boilers is due to Prof. W. A. Bone, Professor of Chemistry at the Imperial College of Science. These boilers are now used both in connection with town or producer gas, or with waste heat from gas engines and large industrial furnaces. Among the advantages claimed are those accruing from the absence of brick-work setting, flues or chimneys, whilst, as was pointed out by Mr. Christie last week, considerable economy follows, in as much as the valuable by-products from the coal are available. In addition to this the efficiency of the gas-fired boiler is claimed to be as high as 92·7 per cent. This figure is a result of a ten-hour test carried out by an independent expert on an unlagged Bonecourt boiler and feed-water heater working on coke-oven gas, and evaporating 4,980 lbs. of steam from and at 212° F. per hour. The question of space is also an important one, and the company state that four Bonecourt gas-fired boilers dealing with 12,000 h.p., occupy a space of only 48 ft. by 33 ft. The boiler for use with town or producer gas consists of a cylindrical drum traversed by straight tubes 6 in. in diameter and 7 ft. long, each tube being packed with patent refractory packing, and having separately controlled combined gas valves and burners. It is calculated that about 10 per cent. of the combustion takes place by flame, but by far the greater part is achieved by surface combustion on the refractory material inside the tubes.

RECENT ELECTRICAL PROGRESS IN THE UNITED STATES

Annual Meeting of U.S. National Electric Light Association

THE thirty-ninth convention of the U.S. National Electric Light Association has recently been held in Chicago, and some interesting reports were presented by the various committees of the Association. According to the *Electric Railway Journal*, the report of the Committee on Electrical Apparatus dealt mainly with standardisation, particularly with regard to sizes, voltages, and taps for transformers. Attention was directed to the fact that during the past five years the capacities of single generating units have increased more than three-fold. On the subject of minimising noise in sub-stations, the following design features were mentioned: The foundations for the apparatus should be separate and distinct from the walls of the building to prevent the transmission of noise; walls should be built with air spaces to form a cushion to impede the direct transmission of noise; windows should be omitted from the walls of the sub-station building. Sub-stations provided with forced ventilation should be carefully designed to avoid the transmission of noise to the outside through the ventilating system; in some cases it is required that the air passages be equipped with baffles to prevent the transmission of sound. Methods of installation which materially assist in a reduction of noise include the use of felt pads under transformers, regulators, &c., or the isolation of noisy apparatus in separate sound-proof rooms. It is believed by the committee that manufacturers pay too little attention to the reduction of noise in apparatus.

An interesting development in the starting of heavy rotating elements of large machines, such as synchronous converters, is the application of a high-pressure oiling system to bearings where it is desirable to reduce the starting current to a minimum. Oil may be forced to the bearings at sufficient pressure actually to raise the rotating element out of mechanical contact with the bearings so that it floats on a film of oil. The high pressure is shut off as soon as the machine starts.

The application of single-phase service to transportation and other fields frequently involves the use of synchronous condensers for power factor correction and voltage regulation. The construction of these involves some unusual conditions in certain situations, such, for example, as where one phase is grounded. Such machines have been constructed for direct application to 11,000-volt systems requiring insulation suitable for use on a 19,000-volt three-phase system. The difficulties involved in converting three-phase energy into single-phase energy have led to the development of the phase converter. As compared with a straight motor-generator for converting three-phase to single-phase current, the phase converter is cheaper, more efficient and more flexible.

The committee stated that two new pieces of laboratory apparatus may now be considered as standardised for general use, namely, the harmonic analyser and the cycle recorder. The analyser provides an efficient and accurate method for determining the components in an alternating current or e.m.f., which otherwise would require tedious mathematical processes. The cycle recorder is used in testing the time elements of high-accuracy relays and circuit-breakers. Its pointer commences to revolve one step per cycle the instant that power is applied to the test circuit. Its particular field is in measuring elapsed intervals of time too short to be satisfactorily observed with a stop watch, and where readings in steps of one alternation are sufficiently accurate for the purpose in view.

Improvements in electrolytic lightning arrestors during the year have included a new form of electrolyte which may be operated at higher temperatures, namely, up to 135 deg. Fahr. In the application of electrolytic arresters for d.c. low-voltage protection, a charging gap has been added to the equipment, with arrangements for closing the gap for daily charging. A new lightning arrester for use in d.c. generating stations, or for the protection of railway equipment was also described. It consists of a condenser in parallel with a resistance, and both in series with a spark gap between line and ground. The improvement consists in the use of a flat plate condenser with a new insulating wax of much higher dielectric strength than paraffin. For the protection of railway equipment and station apparatus up to 1,500 volts, a condenser of 1 m.f. capacity is used, while for line mounting, a 0·3-m.f. condenser is used. The gap may be safely short-circuited as the resistance of the condenser shunt is high.

The report of the Committee on Underground Construction was largely devoted to details of conduit construction, cable installation and cable testing. The process of making "stone" conduits, the material for which is fine limestone screenings and Portland cement in proportions of 4·75 to 1, was described. This conduit is made in lengths of 5 ft. and of an internal diameter of 2½ in., and a wall thickness of ⅝ in. It is laid with a minimum of 1 in. of concrete between ducts and between layers, and with a 3-in. concrete envelope. One company has installed 10,000,000 ft. of this conduit.

The committee described a new type of cable joint in which ingenious insulating forms are used for separating the conductors of a cable. These forms are constructed of thin sheets of mica cemented together and made up over an iron core. A porcelain spacer at each end holds the separators symmetrically about the three conductors and centrally in the lead sleeve. Another type of joint, known as a vacuum joint, was also described. In this the insulating material is forced into the sleeve and all air is eliminated by exhausting the interior of the sleeve to a high vacuum.

An apparatus for testing cables was also described by means of which it is possible to measure direct current in a single-conductor cable without opening the circuit. The instrument consists of two parts, a coil and a meter. The coil is an iron ring wound with a large number of turns of small wire, and having a hinged section which opens to permit the ring to be slipped over the conductor. In the core is a small air gap in which a polarised magnet is pivoted. This magnet is free to turn according to the polarity of the core poles terminating at the air gap. When the coil is slipped over a conductor carrying a direct current the core is magnetised and the needle is deflected and makes contact completing an electric circuit through a relay and indicator. Current from a battery is sent through the coil to neutralise the effect of the current in the conductor, and a condition of neutralisation is indicated by the polarity indicator. The current necessary for this purpose, which is measured by an ammeter, is proportional to the current in the conductor. The apparatus comprises an adjustable resistance for use in varying the current in the coil.

The committee directed attention to the importance of cooling of duct lines under certain conditions, some cable failures having been shown to be due to overheated cables. The temperature of a duct of any given construction will vary with changes in the character of the soil through which it runs. A line which gives no trouble from overheating in moist soil might overheat in dry or sandy soil. Attempts have been made to produce artificially the conditions favourable to rapid heat dissipation, but as yet none have shown results to justify general adoption. One of these is the use of a porous tile drain laid in a trench above the conduit line. Another is the sprinkling of the duct line.

CORRESPONDENCE

CITY AND GUILDS WIRING EXAMINATIONS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—We notice that at the annual general meeting of the Electrical Contractors' Association Mr. W. R. Rawlings referred to his appointment as Examiner in "Electric Wiremen's Work" for the City and Guilds of London Institute, and to the fact that at present no more than 25 per cent. of the enrolled students attend the examinations.

We do not think this is so much the fault of the examinations as of lack of proper tuition and of facilities for the same. There is proof of this in the fact that, compared with the electrical engineering subjects, a mere handful of people take up electric wiring. The reverse ought, of course, to be the case.

Whatever views one may have on the scope of past examination papers, it must not be forgotten that the inclusion of the subject "Electric Wiremen's Work" in the C.G. Syllabus was largely due to the efforts of the resigning examiner, Mr. Frank Broadbent, and the profession and trade are heavily indebted to him for that and for his subsequent work.

We gather from the report of the meeting that Mr. Rawlings is going to give us something fresh in the way of examination questions, and that the latter will tend more to the practical than to the theoretical side of the subject.

While that is good news, we should like to point out that unless the methods of tuition are radically overhauled beforehand, there will not be any more grist for the mill than there has been hitherto.

As the Electrical Contractors' Association is so closely concerned with the matter, they should certainly make themselves and their wants known to those in charge at our technical institutes all over the country, some of whom hardly recognise the existence of the subject of "Electric Wiremen's Work."

Yours faithfully,

A. P. LUNDBERG & SONS.

477 to 489 Liverpool Road, Islington, N.

July 7th.

THE I.E.E. AND THE INDUSTRY

Proposals to Government Committee

As we recently mentioned, the Government has appointed a Committee to deal with matters affecting the electrical engineering industry (Electrical Engineering, April 27th, p. 147), and from the *Journal* of the Institution of Electrical Engineers for June it appears that this Committee is the direct outcome of a suggestion from the Council. A Committee of the whole Council of the Institution recently had under consideration certain matters affecting the electrical engineering profession, but shortly before a report was presented to the Council, announcements were made in the Press of the appointment of Committees to consider the position of certain British industries after the war, especially in relation to international competition. The Council immediately made a suggestion for the appointment of an Electrical Trades Committee, and this suggestion having been acted upon, the President has been asked to give evidence. It has been resolved to place the following recommendations, based upon the conclusions reached by the Committee of the whole Council, before the Government Committee dealing with the electrical trades :—

1. Some combination of British electrical firms, especially with regard to overseas trade, is desirable.
2. A Government Tribunal of the most independent character that can be devised to be appointed to control the electricity supply industry of the country, and also to prevent indiscriminate addition to or extension of power stations or systems undesirable from the point of size, locality, or system.
3. In view of the necessity of securing the home market, and that none other than British electrical apparatus be purchased in the United Kingdom, a protective tariff to be set up, notwithstanding such benefits as will in any case result from patriotism.
4. A permanent Advisory Committee to be appointed to ensure that, as far as possible, raw materials and parts, as well as whole apparatus necessary to the trade of the British Empire shall be produced within the Empire.
5. (i) British-born electrical Attachés to help in the Consular service, and (ii) Trade Commissioners (scientific and technical Commissioners as suggested by Mr. Pollard Digby, I.E.E. *Journal*, Vol. 53, p. 799, 1915) to be appointed.
6. British engineering standards to be adopted throughout the Empire.
7. The use of the metric system to be made compulsory after a reasonable period; and during this period all trade catalogues to make use of both the British and metric systems.
8. The Institution to be granted a charter so as to improve the status and training of electrical engineers.
9. A Central Engineering Board, consisting of representatives nominated by all the important institutions, to be established whom all engineers (other than mechanics) would be required to satisfy as to the sufficiency of their technical training and general education before they could be recognised as proficient, so as to ensure that every engineer shall qualify for his profession in the same manner as a doctor or solicitor.
10. Closer co-operation of manufacturers and other employers and electrical engineers with the technical colleges is desirable to ensure that students are trained to meet the future needs of the industry.

THE INSTITUTION AND THE FORCES

Roll of Honour

The following additions to the Roll of Honour of members of the Institution of Electrical Engineers are made. The previous list of those who have laid down their lives for their country was given on p. 160 of our issue for May 4th :—

Killed in Action.—2nd Lieut. H. W. Corke, Gloucestershire Regt.; Lieut. G. B. Dyke, R.G.A.; Lieut. F. W. Eagle, R.E.

Died of Wounds.—2nd Lieut. T. O. H. Bates, Indian Infantry; 2nd Lieut. G. H. Eardley-Wilmot, Machine Gun Corps.

Died.—Pte. J. Cheshire, Manchester Regt.; Pte. T. Duesbury, Royal Berkshire Regt.

Military Honours.

The following additional military honours have been awarded. Previous lists appeared in our issues for April 20th, p. 140, and February 10th, p. 48.

Companion of the Bath.—Capt. H. R. Sankey, R.E.

Distinguished Service Order.—Capt. D. S. Collins, R.E.; Major J. H. Mousley, R.E.

Military Cross.—Lieut. S. G. Anderson, R.E.; Lieut. T. Challoner, Glamorgan (Fortress) R.E.: "For consistent good work previous to an attack. He went out twice and made reconnaissances under heavy shell fire."—*London Gazette*, May 16th, 1916; Lieut. H. A. Denison, King's Royal Rifle Corps: "For conspicuous gallantry on several occasions, notably when he attacked a strong enemy patrol with five men, and after inflicting loss on them with bombs, withdrew without casualties under very difficult circumstances."—*London Gazette*, May 16th, 1916; Lieut. B. Z. de Ferranti, R.G.A.; Lieut. E. M. Marvin, R.E.: "For conspicuous gallantry. He went out and rescued a severely wounded man of a working party, carrying him on his back some hundred yards in bright moonlight under heavy machine-gun and rifle fire."—*London Gazette*, May 31st, 1916; Major T. V. Smith, R.F.C.; Major J. Wayne-Morgan, Glamorgan (Fortress) R.E.

Distinguished Conduct Medal.—Sergt. C. B. Colston, R.E.: "For consistent good work and devotion to duty."—*London Gazette*, June 21st, 1916; Sapper E. H. Vick, R.E.: "For conspicuous gallantry when repairing telephone wires under heavy fire."—*London Gazette*, June 21st, 1916.

Military Medal.—2nd Corpl. C. J. Burrage, R.E.

Legion of Honour (Croix de Commandeur).—Col. G. P. Seligmann-Lui, French Military Telegraphs.

Legion of Honour (Croix d'Officier).—Brevet Lieut.-Col. A. H. Dumaresq, R.E.

Members on Military Service.

Below is the eighth list of members of the Institution serving with the Forces. The last list appeared in our issue for April 20th, p. 140.

Members.—Lieut. G. Van Corbac, Canadian Infantry; Major J. H. Dobson, South African Pioneer Corps.

Associate Members.—Major R. D. T. Alexander, London Scottish; 2nd Lieut. T. H. Birrell, Glamorgan (Fortress) R.E.; Capt. J. C. Briggs, Leicestershire Regt.; L. F. Burgess, Australian Imperial Force; J. D. Butcher, Singapore R.E. Volunteers; Capt. W. G. Clarke, R.E.; Lieut. E. H. Cockshott, R.N.A.S.; Lieut. N. R. Corke, Canadian Infantry; J. P. Crowther, London Elec. Eng.; Lieut. J. C. de Wardt, Kent (Fortress) R.E.; 2nd Lieut. W. E. Dove, R.G.A.; Elec. Artificer C. F. Dyer, R.N.; H. A. Eastman, R.E.; Warrant Eng. C. H. Fox, R.N.R.; E. Graves, South Lancashire Regt.; Lieut. W. H. Hart, A.S.C.; D. Jackson, London Elec. Eng.; T. W. Jeffreys, London Elec. Eng.; R. O. Kapp, Artists Rifles O.T.C.; 2nd Lieut. H. Kingsbury, R.G.A.; Lieut. H. I. Lewenz, Staff for R.E. Services; P. M. Martin, London Elec. Eng.; 2nd Lieut. F. A. Menzies, Reserve of Officers, Indian Army; H. W. Nimmo, London Elec. Eng.; G. W. P. Page, London Elec. Eng.; Corpl. G. A. Partington, London Elec. Eng.; Staff-Sergt. M. L. Peel, Cape Fortress Engineers; G. O. Scampton, London Elec. Eng.; Capt. F. N. Shumaker, R.F.C.; 2nd Lieut. C. Singleton, R.E.; Lieut. T. R. Stancombe, A.O.D.; F. C. Stephens, South African Overseas Force; 2nd Lieut. F. E. M. Thrupp, R.E.; E. S. White, London Elec. Eng.; Major G. B. Williams, London Signal Service, R.E.; 2nd Lieut. J. L. Winter, City of Edinburgh (Fortress) R.E.

Associates.—Lance-Corpl. F. C. Heritage, London Elec. Eng.; E. A. Nash, Artists Rifles O.T.C.; C. A. Pilson, R.N.A.S.

Graduates.—2nd Lieut. F. N. H. Beamish, Royal Warwickshire Regt.; E. S. Bolton, London Elec. Eng.; H. Bond, R.F.A.; Sub-Lieut. C. K. Chandler, R.N.V.R.; Qmr.-Sergt. T. Drummond, New Zealand Engineers; K. J. Kirkpatrick, Artists Rifles O.T.C.; Sub-Lieut. C. A. Smiles, R.N.V.R.

Students.—2nd Lieut. G. E. Barton, Cheshire Regt.; 2nd Lieut. C. B. Colston, R.E.; Elec. Artificer K. Davidson, R.N.; E. A. H. French, London Elec. Eng.; H. C. Gibson, London Elec. Eng.; 2nd Lieut. H. V. Higby, Indian Infantry; 2nd Lieut. H. B. Lee, R.E.; D. McCourt, R.E.; 2nd Lieut. D. E. Nicolle, R.F.C.; D. A. Rankin, London Elec. Eng.; W. A. Rayn, Inns of Court O.T.C.; Lieut. G. B. Whitaker, R.E.

Promotions, Transfers, &c.

Additional promotions are as follows :—

Members.—Lieut.-Col. W. Bridges, London Brigade, R.F.A.; Bt. Lieut.-Col. A. H. Dumaresq, R.E.; Capt. S. B. Haslam, Rifle Brigade; Capt. W. H. U. Marshall, Dorset (Fortress) R.E.; Capt. R. K. Morcom, R.E.; Maj.-Gen. A. M. Stuart, C.B., Director of Works.

Associate Members.—Capt. R. Amberton, Royal Fusiliers; Lieut. C. L. Arnold, R.G.A.; Major J. S. Barker, M.V.O., R.E.; Lieut. S. W. Carty, A.S.C.; Lieut. T. Challoner, Glamorgan (Fortress) R.E.; Lieut. I. S. Dalgleish, London Elec. Eng.; Eng. Sub-Lieut. J. C. Eadie, R.N.; 2nd Lieut. A. W. Empson, R.F.C.; Major B. C. Gardiner, R.M.L.I.; 2nd Lieut. V. W. Gill, Royal Fusiliers; 2nd Lieut. L. V. Harris, R.E.; Lance-Corpl. W. Hodson, Royal Sussex Regt.; 2nd Lieut. G. A. Hollings, R.E.; 2nd Lieut. D. G. Hurlbatt, Indian Infantry; Lieut. W. C. C. Langdon, R.G.A.; Lieut. R. F. Long, R.F.A.; Corpl. F. H. Mann, Divisional Engineers, R.N.D.; Lieut. E. M. Marvin, R.E.; Lieut. A. R. Z. Porter, London Elec. Eng.; 2nd Lieut. L. H. Pratt, R.E.; Lieut. A. W. Puttick, Royal West Kent Regt.; Lance-Corpl. W. D. Redfern, East Lancashire R.A.M.C.; Lieut.-Col. G. B. Roberts, R.E.; 2nd Lieut. R. Shaw, City of Edinburgh (Fortress) R.E.; Major T. V. Smith, R.F.C.; Lieut. H. D. Staniar, R.E.; Lieut. R. H. N. Vaudrey, R.E.

Associates.—Lieut. P. W. McDougall, R.N.V.R.; Capt. S.

Pilkington, Leicestershire Regt.; Lieut. M. H. Vickerman, A.S.C.

Graduates.—Major A. L. Lintott, Machine Gun Corps; Lieut. L. T. G. Mansell, R.F.C.

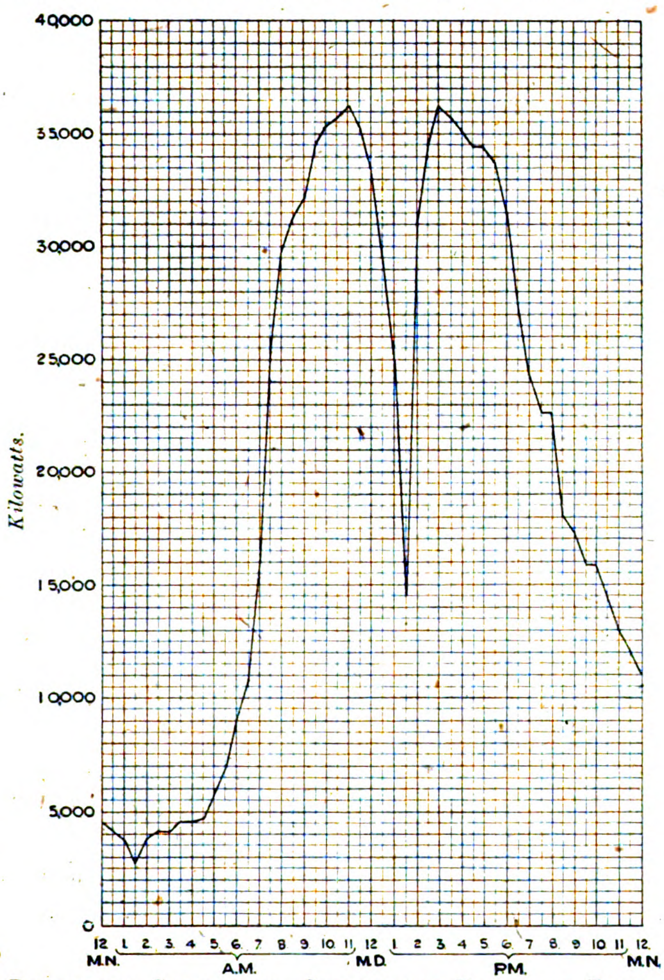
Students.—Capt. J. Aylmer, Royal Fusiliers; 2nd Corpl. C. J. Burrage, R.E.; 2nd Lieut. R. M. Clark, R.E.; Lieut. N. Devonald, R.G.A.; 2nd Lieut. D. Dunham, South Lancashire Regt.; R. C. Dunn, A.O.C.; Sergt. L. G. Floyd, London Elec. Eng.; 2nd Lieut. J. B. Hartley, R.G.A.; Capt. A. T. Hitch, Bedfordshire Regt.; 2nd Lieut. B. E. G. Mittell, R.E.; Corpl. A. Priestley, Divisional Engineers, R.N.D.; Lieut. W. J. Rawlings, London Elec. Eng.; Lieut. S. M. Rawson, Royal Fusiliers; 2nd Lieut. W. G. Spencer, R.E.; 2nd Lieut. H. J. Stone, R.E.; Lieut. G. O. Tipping, Devon (Fortress) R.E.; Capt. H. R. Tuppen, A.S.C.

DAYLIGHT SAVING ACT

Effect on Electricity Supply Undertakings

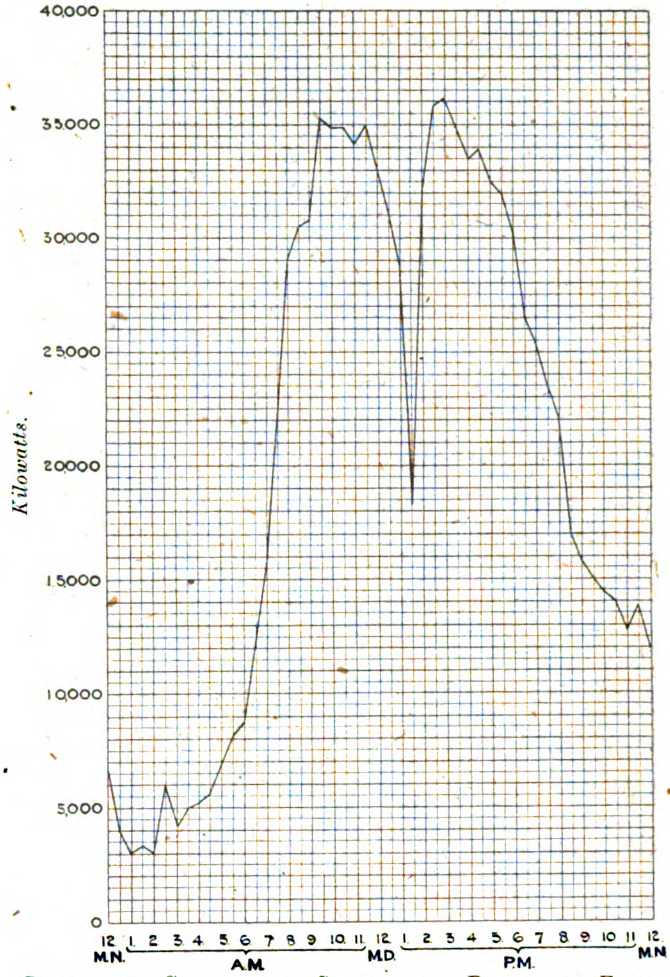
IN connection with the article on this subject, which appeared on page 238 of our issue for June 29th, we are now able to add a couple of curves showing the effect upon the Birmingham Corporation Electric Supply Department, and to give a few figures of the effect which it is anticipated the Summer Time Act will have upon a number of other undertakings.

In the case of Birmingham there would appear to be a reduction in the demand between 8 and 11 p.m., and an increase from 11 p.m. to 1 a.m. on May 22nd, as compared with May 15th, and this amounts to approximately 1,000 kw. As the output supplied for light only now represents about 10 per cent. of the total output, and as the reduced demand between 8 and 11 p.m. is to some extent met by the increased demand after 11 p.m., it cannot be said that the Birmingham undertaking has been affected to any appreciable extent by the Summer Time Act. This bears out, more or less, the experience of a number of other towns similarly situated to Birmingham.



BIRMINGHAM CORPORATION.—SIMULTANEOUS DEMAND ON ENTIRE SYSTEM ON MONDAY, MAY 15TH, 1916.

At the same time, at Nottingham, a manufacturing town of a rather different character, there has been a big reduction in the output, although we have not yet the exact figures. On the other hand, at Sunderland, any effect of the Act on the total load has been obliterated by increase in power load, because the total output is greater since the Act came into operation.



BIRMINGHAM CORPORATION.—SIMULTANEOUS DEMAND ON ENTIRE SYSTEM ON MONDAY, MAY 22ND, 1916.

Serious results are foreshadowed at St. Pancras, where the reduction in revenue is put at no less than £7,000 per annum, and at Bristol the reduction in revenue is expected to be about £2,000.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"The Localisation of Faults in Electric Light and Power Mains; with Chapters on Insulation Testing." By F. C. Raphael. 210 pp. 8¾ in. by 5½ in. 128 figures. (London: The Electrician Printing and Publishing Co., Ltd.) Third edition, revised. 8s. 6d. net; abroad, 9s.

"Pole and Tower Lines for Electric Power Transmission." By R. D. Coombs. 272 pp. 9¼ in. by 6¼ in. 163 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 10s. 6d. net.

"The Principles of Apprentice Training: With Special Reference to the Engineering Industry." By A. P. M. Fleming and J. G. Pearce. 202 pp. 7¾ in. by 5 in. (London: Longmans, Green & Co.) 3s. 6d. net; abroad, 3s. 10d.

"The Year-Book of Wireless Telegraphy and Telephony, 1916." 876 pp. 8½ in. by 5½ in. 29 figures. (London: The Wireless Press, Ltd.) 3s. 6d. net; by post, 4s. 1d.; abroad, 4s. 8d.

"A Manual of Practical Physics." By H. E. Hadley. 265 pp. 7 in. by 4¾ in. 153 figures. (London: Macmillan & Co., Ltd.) 3s.; abroad, 3s. 3d.

"Discovery: Or the Spirit and Service of Science." By R. A. Gregory. 340 pp. 7½ in. by 5 in. 8 figures. (London: Macmillan & Co., Ltd.) 5s. net; abroad, 5s. 8d.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,502.

I am in charge of a test room in which we have a small D.C, separately excited generator, with interpoles giving 2 amps. at 600 volts. A much larger one has now been installed, and I wish to use the small one as a motor, but find on connecting up that it only revolves very slowly and also sparks badly. I have tried changing over the interpole-connection, but with no better result. What is the trouble?—INTERPOLE.

(Replies must be received by first post Thursday, July 20th.)

ANSWERS TO No. 1,500.

A 15-kw. 200-volt generator with connections as shown in Fig. 1, but without any equaliser connection (this being the only generator), had the armature removed to true up the commutator in a lathe. It was removed from the back end of the machine to save undoing any connections. All dirt was removed from the armature and the machine generally, and all the winding was varnished. It was noticed that the brushgear

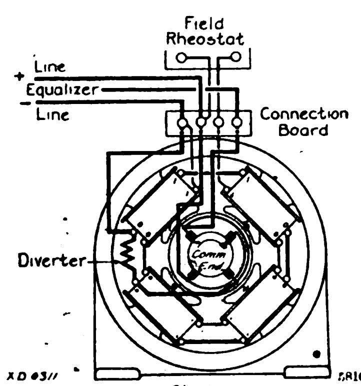


FIG. 1.

insulation was oily, and to remove it one brush-pin at a time was taken out and was put back before another was removed. Not more than one connection was undone at one time to avoid any possible mistake when reconnecting. When the machine was reassembled and the brushes bedded to the commutator surface it would not excite when put to work, but it immediately excited when the brushrocker was moved round 90 degrees. The rocker had not been previously moved. Why is this?—ELECTRICIAN.

The first award (10s.) is given to "Y. Z." for the following reply:—

The statement in the question regarding this mystery does not throw light on the previous history of this remarkable machine, but it is presumed that it would excite without difficulty before the various operations described were carried out. Let us take them one by one. Removing the armature from the back end of the machine would not have the result indicated unless it got what the pitman would call an "aaful nasty twist," that shifted the core round 90° relatively to the commutator. The avoidance of any disconnecting would, in all probability, leave the machine just as it was in this respect. The removal of dirt, and the varnishing of the winding are negligible factors. The turning of the commutator is also an improbable cause of trouble, unless the twist came in here, and the tool pushed the commutator round 90° on the shaft. The removal of the brush pins might cause the trouble, provided they were put back with the brush-holders arranged on the opposite side of them from their previous setting, as that would probably connect each brush stem to a point something of the order of 90° away from its old place, even if the actual position of the brush-pin were not changed. If only one pin were removed at a time, however, it is not easy to see how this could happen. If only one connection were undone at a time, and reconnected for safety before the rest was uncoupled, as seems to be indicated in the question, there does not seem to be much chance of error there.

Now comes the mystery; the machine will not excite until the rocker, which has previously not been moved, is turned through 90°! All that can be said is that something has happened—some inadvertent or overlooked reconnecting or replacing in a new way that altered the relation between the field and the armature—to make this movement necessary. The statement says that no such thing occurred; it is assumed that the dynamo was right before it was disturbed; the result makes it certain that some such thing *must* have occurred, but the question throws no light on where, when, why, or how it happened. It reminds one, in fact, of the story of Jane and John. John said that his father was Jane's father, and his mother was Jane's mother, and yet Jane was not his sister. What was John? The answer is too well known to need repetition here; but as none of the processes described in the question could have the result indicated, the two cases do seem a little analogous.

[While not going so far as "Y. Z.," we imagine that "Electrician" has been deceived.—ED., *E.E.*]

The second award (5s.) is made to "Koil" for the following:—

Provided the machine had been running satisfactorily prior to the overhaul being undertaken and the roughness of the commutator and dirtiness were the only reasons for taking it adrift, it is obvious that the trouble obtained was due to incorrect reassembling.

Failure to excite until the brushes had been moved through 90° would result from interchanging at the armature the connection from the + terminal and that from the series winding.

Or, putting the brush boxes on to their spindles wrong way (*i.e.*, so that the machine runs "against" instead of "with" the brushes, or *vice versâ*), would in some cases demand the same remedy. For instance, in some brush-boxes the brush is held at a distance of 2 in. to 2½ in., or even more, from the centre of the supporting spindle. Reversing these boxes removes them 4 in. to 5 in. from their original position, which represents quite a big angle, in the region of 60° to 90° on a small commutator.

Compulsory Patent Licences for the Italian State Railways.—A recent Italian Government decree announces that the Administration of the State Railways has been granted authority to make use of any patented invention which can be applied in the public interest without waiting for permission from the owner of the patent. Failing a settlement between the Administration and the owner of the patent as to the terms of a licence, these are to be settled by an Arbitration Committee composed of three experts nominated by the President of the Appeal Court.

Electrical Engineering Text-books for British Prisoners of War.—The Secretary of the Institution of Electrical Engineers has been informed that the Board of Education will be glad to receive gifts of standard text-books on electrical engineering subjects for distribution among British prisoners of war interned abroad, from whom several requests for books of this kind have been received. All books and communications on the subject to be addressed to A. T. Davies, Welsh Department, Board of Education, Whitehall, S.W.

The Institution and its Enemy Members.—We understand that the Council of the Institution of Electrical Engineers has in preparation a list of those who will cease to be members of the Institution under the resolutions recently passed dealing with enemy members, and that this list will be published as soon as possible.

Electric Post Coaches in Switzerland.—According to the *Neue Zürcher Zeitung*, horse-drawn postal vehicles on the service Locarno-Ascona-Brissago are to be replaced by electric automobiles.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published July 6th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

4,080/15. **Resistances.** W. Just. A highly refractory material suitable for resistances to be worked at high temperatures composed of a mixture of carborundum and zirconia.

8,748/15. **A.C. Motors.** B.T.-H. Co. and J. Martin. An arrangement for running several induction motors at the same or proportional speeds from a common supply, which consists in connecting-corresponding phases of the rotors in parallel to the starter and regulating resistances through reactances. (Two figures.)

10,857/15. **Flexible Cables.** A. J. Downe. Flexible cords for portable apparatus not liable to twisting or kinking, consisting of two ordinary flexible strands and one dummy plaited together. (One figure.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Cole [Distributing system] 7,457/15.

Dynamos, Motors, and Transformers: A. G. Brown, Boveri & Co. [Motor control] 4,222/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Speed control for motors] 11,768/15; Pieper and Pieper [Rotary converters].

Electrometallurgy and Electrochemistry: Nelson [Electrolysis] 10,605/15; Aktiebolaget Elektriska Ugnar [Current regulators for furnaces] 17,022/15.

Heating and Cooking: Marks (*Walker*) [Water heating] 9,097/15.

Ignition: Swyers [Ignition switches] 1,950/15; Pedersen [Magnetos] 9,034, 14,845, 14,896, and 14,898/15; Williams [Ignition apparatus] 10,585/15.

Incandescent Lamps: A.B.C. Schriftlampen Ges. [Incandescent lamps] 7,591/14.

Instruments and Meters: Landis & Gyr [Measuring instruments] 7,341/15.

Telephony and Telegraphy: Bardeloni [Telephone systems] 8,826/15; Marconi's Wireless Telegraph Co. and Wright [Wireless telegraph receivers] 3,926/15; Relay Automatic Telephone Co. (*Betulander*) [Automatic telephones] 9,283/15; Automatic Telephone Mfg. Co. [Automatic telephones] 9,396/15.

Miscellaneous: Maître and Martin [Electric pianos] 7,890/14; Varley Duplex Magnet Co. and Varley [Discharge apparatus] 9,111 and 9,112/15; Nicolson and Hull [Electron emitting cathodes] 17,580/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Distribution: Thury [Constant current supply] 13,801/15.

Ignition: Bosch Magneto Co. [Ignition and starting apparatus] 7,933/16 (*100,684*).

Telephony: (S. C. Porter [Transmitter] 8,305/16 (*100,689*).

Traction: W. A. Chryst [Engine starters] 5,732/15 (*100,677*); Bosch Magneto Co. [Engine starters] 7,731, 7,732, and 7,733/16 (*100,682, 100,683,* and *100,684*).

Miscellaneous: Wilson [Arc welding] 18,115/15; J. C. Ruttes [Electric and steam power generator] 8,474 and 8,476/15 (*100,691* and *100,692*).

Amendment allowed

2,489/15. **Portable Lamp.** H. J. C. Forrester. This specification has been amended by way of disclaimer. It describes a portable lamp with a sucker in the base by which it can be attached to any flat surface.

Opposition to Grant of Patents

Opposition has been entered to the grant of a patent on the following application:—

7,829/15. **Metal Filaments.** K. Nishimoto. A mixture of finely-powdered tungsten and thorium is consolidated into sticks by pressure, sintered electrically, allowed to cool slowly, and, while at a dull red heat hammered and rolled.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

16,041/12. **Resistances.** A. Reyrolle. A form of solid block resistance built up of powdered carbon, graphite, or other material clamped between a series of iron plates.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: W. Hepworth Collins [Cable conduits] 5,865/05.

Dynamos, Motors, and Transformers: Electromotors, Ltd., and J. H. Hamilton [Brush holders] 5,820/05; Lancashire Dynamo & Motor Co., Ltd., and A. R. Stelling [Slip rings] 6,477/09.

Electrometallurgy and Electrochemistry: H. Danners and Langbein Pfanhauser Werke A.G. [Electroplating wire, &c.] 6,527/08.

Incandescent Lamps: Westinghouse Metal Filament Lamp Co. [Metal filaments] 6,936/07.

Storage Batteries: H. Rodman [Battery plates] 5,957/07.

Switchgear, Fuses, and Fittings: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Motor starter] 6,967/07 and [Grid resisters] 6,674/07; Childs and T. E. Hill [Battery regulators] 6,752/09.

Telephony and Telegraphy: Siemens Brothers Dynamo Works, Ltd. (*Siemens & Halske A.-G.*) [Telephone exchange system].

ENGINEERING EDUCATION AND RESEARCH

THE subject of the organisation of science and engineering throughout the country, particularly as regards education and research, is at present receiving a great deal of attention, and there has just been published a very interesting report by the Council for Organising British Engineering Industry. The report is one of the Committee on Engineering Education and Research, and contains a number of recommendations which may be briefly summarised as follows:—

1. The organisation of British engineering industry, by the federation of British manufacturing engineers, for purposes which include education and research. Such a federation should co-operate with governing bodies of schools and colleges, education authorities, universities, and with the Government.
2. The provision of an adequate and more uniform system of scholarships. To this end the number of local education authorities for the highest education should be reduced, correspondingly larger areas being assigned to each.
3. That a large number of junior technical schools be established for the education between 12 and 15 of boys who intend to become apprenticed to engineering trades.
4. That, subject to certain exceptions, all apprentices under 18 years of age be required to attend part-time classes for, say, 8 hours a week during works hours.
5. That the instruction given to trade apprentices in these part-time classes be reformed so as to relate it more closely to the apprentices' everyday work and so as to include what are known as citizenship subjects—for example, economic history.
6. That the specific education given to future members of the highly-trained staff be provided in a university or college of university rank for the majority who should be enabled to continue their studies up to 21 or 22 years of age; and in a senior technical school for the minority who may have to enter engineering works at 18.
7. That boys who are to study engineering in a university should carry their study of mathematics and physical science to a higher stage before leaving school.
8. That the conditions for admission to universities should be reconsidered and rendered more uniform as between different universities.
9. The reform of university teaching in certain important respects, notably by a reduction in the number of lectures.
10. That the completion of a three years' university course in engineering should entitle students to no more than the B.A. degree; and that, until candidates have added works experience to academic training, they should not receive technical degrees (such as Bachelor of Engineering or Bachelor of Technical Science) which might then serve as professional qualifications.
11. That any time spent in works between school and college should not be unduly prolonged.
12. That university teachers be encouraged to undertake re-

search on behalf of, and in co-operation with, manufacturing firms; and that additional Government grants be paid to universities and colleges with this end in view.

13. That, by the establishment of an association of manufacturing engineers and other means, the volume of research work carried out in connection with British engineering industry be greatly increased; and that provision be made for this increase by fully utilising and extending the facilities already available in universities and colleges, as well as in the works of private firms, and also by establishing a central research laboratory for investigations that cannot be carried out elsewhere.

UTILISATION OF TURBINES FOR THE GENERATION OF CONTINUOUS CURRENT

ALTHOUGH continuous-current turbo-generators of various sizes up to about 2,000 kw. have been designed and are running successfully, these machines are not altogether satisfactory from the point of view both of the designer and electrical manufacturer. In dealing with the problem the designers of both ends of the set have to compromise in order to make a satisfactory machine. The steam-turbine designer has to reduce the speed of the turbine at the expense of efficiency, while the generator designer runs his machine at a higher speed than is desirable for satisfactory commutator construction. The ideal solution, of course, is that the turbine should run at the high speed necessary to secure the best efficiency, while the commutator should be worked at a sufficiently low peripheral speed to prevent commutator troubles. Recently two solutions of the problem have been resorted to :—(*a*) Slow-speed generators driven by turbines through gearing; (*b*) turbo-alternators driving rotary converters coupled direct electrically.

An example of the second solution is afforded at the works of Messrs. Fraser & Chalmers, Ltd., of Erith, where an installation was laid down at very short notice. In this installation

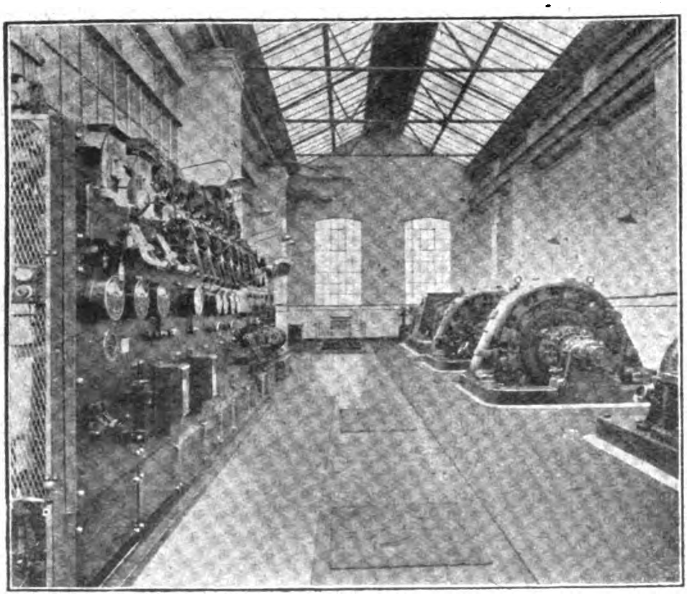


FIG. 1.—1,500-KW. "WITTON" TURBO-ALTERNATOR DRIVEN BY FRASER & CHALMERS TURBINE, AND OPERATING IN CONJUNCTION WITH "WITTON" ROTARY CONVERTERS FOR GENERATING CONTINUOUS CURRENT.

the proposals of the General Electric Co., Ltd., of London and Witton, Birmingham, comprising turbo-alternators and rotary converters, were accepted as being both reliable and economical. The installation consists of a 1,500-kw. generating unit composed of a Fraser & Chalmers turbine running at 3,000 r.p.m., and driving a "Witton" six-phase turbo-alternator generating three-phase power at 325–370 volts, 50 cycles. This unit is coupled electrically to two 750-kw. "Witton" rotary converters, running at a speed of 500 r.p.m., and generating continuous current at 440 volts, which is supplied to the "Witton" switchboard on the left-hand side of Fig. 1.

The two rotary converters run in parallel from one winding of the turbo-alternator, and, as is well known, unless precautions be taken trouble is met through the two rotary converters being connected in parallel on both the alternating-current and the continuous-current sides. In the early days of rotary converter operation it was found impracticable to run two rotary converters off the same transformer, due to the fact that there exists between each phase bus-bar and the continuous-current bus-bars a number of parallel paths of low resistance. The resistance of these paths is made up of the resistance of the connections, the converter armature, brushes, and brush-contacts. Although the total is low, the brush-contact resistance constitutes a large portion of the whole, and, in addition, is a variable quantity. Moreover, the current distributes itself according to the resistance of each circuit.

A cross-current flows in, say, the positive connection of two converters, subtracting itself from the current flowing down one lead and adding itself to the current flowing down the other. The result is that bad parallel running ensues. Where transformers are used they may be provided with two or more separate windings, each winding supplying one rotary converter. The same solution may be adopted in the case of generators, but it is not always desired to split up the generator winding into two or more parts. The two windings have been eliminated in a method (Patent No. 11,905/13) introduced by

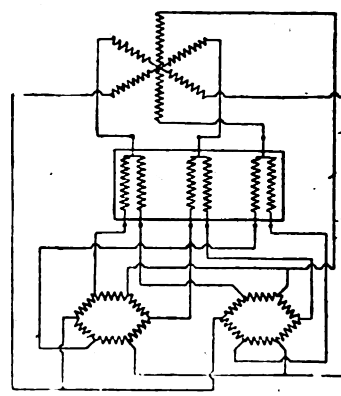


FIG. 2.—DIAGRAM OF THE ARRANGEMENT OF THE BALANCING COILS IN THE ROTARY CONVERTER LEADS TO PREVENT CROSS-CURRENTS.

the General Electric Co., Ltd., and the present installation operates on this principle. Differentially wound balancing transformers are installed in the low-pressure alternating current leads of the rotary converter, as shown in Fig. 2. These balancing tansformers are inserted in each of three of the leads from the converter, as shown in the diagram. They consist of two oppositely-wound windings on the same cores. The alternating current supplying one phase of one converter is passed through one coil of the transformer, while that of the same phase for the other converter is passed through the second coil. Consequently, when the currents are equal their effects cancel out, but should one converter attempt to take more than its share of the load, the excess current magnetises the core and induces an electro-motive force in the other winding, which assists the current flowing therein, and tends to cause it to increase until the two currents flowing are again equal. In this way the loads taken by the rotary converters are equalised, and the

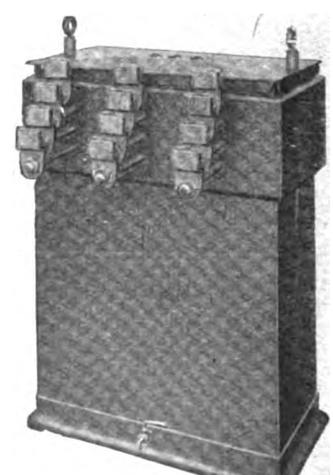


FIG. 3.—ONE OF THE BALANCING COILS.

unbalancing of current brought about by the circumstances related is entirely obviated.

Any number of rotary converters can be coupled to the generator and run in parallel on this principle, and, if necessary, it is possible to take part of the generator output in the form of alternating current, for transforming up and distribution at a suitable pressure to outlying districts. In the present installation, as in others on this principle, the rotary converters are started up with the turbo-alternator and run up to speed with the machine. No synchronising is therefore required.

The arrangement is claimed as offering a completely satisfactory solution to the problem of generating continuous current at a low cost by means of turbines.

ACCUMULATORS FOR SPECIAL PURPOSES

A CATALOGUE that we have received from the Fuller Accumulator Co., Ltd. (Chadwell Heath, London, E.) describes a number of types of storage cells for special purposes, including house lighting and large capacity cells, as well as cells for telegraph, telephone, railway signalling, and electric clock service, train lighting, wireless and field telegraphy, ignition, car lighting, hand lamps, miners' lamps, &c., of the company's well-known "Block" type. These cells, instead of using thin plates, with their liability to buckle, are constructed with electrodes, in which segmental blocks of active material are carried on small grids, and wrapped in porous material. The result is that the electrodes are free from the possibility of injury either by vibration, short-circuiting, or sulphating. They also have the special feature that they will hold their charge from 9 to 18 months without the E.M.F. falling below two volts.

Another pattern of cell is the "Sparta" battery, suitable for the heavy duty of engine-starting on automobiles. This is specially designed to obtain low internal resistance, rapid recuperative power, and robust construction. The elements are of considerable area, grouped in such a manner as to offer the easiest possible passage to the current, and separated by fluted separators, allowing free circulation of acid. The elimination of all celluloid permits the use of a high gravity acid which further reduces resistance. The inter-cell connections are very massive in construction, and are of ample area and special design to facilitate rapid radiation of heat. This is an important factor in reducing resistance. The lugs are of unusual size and solidity, ensuring a permanent and massive connection for the motor leads. The "Sparta" elements are of the pasted type, the positives being sufficiently massive to permit the use of a specially porous oxide, which enables the battery to give a heavy discharge, and at the same time rapidly to recover voltage. Special patterns are made to replace the original batteries on American-made cars of various types, which have found their way to this country, and these should prove very useful to owners of such cars, who will not only prefer a British-made battery of good quality, but who have difficulty in obtaining the American cells in question.

CATALOGUES, PAMPHLETS, &c., RECEIVED

DOMESTIC ELECTRICAL APPLIANCES.—"Universal" hot-water kettles, grills, boilers, coffee urns, electric irons, toasters, and similar appliances are described in an illustrated leaflet issued by The Brompton & Kensington Accessories Co., Ltd. (254-260 Earl's Court Road, S.W.). Traders who wish to hold a special "Universal" week are offered advertising matter, window displays, and helpful suggestions.

STONEWARE ELECTRIC UTENSILS.—We have received an interesting leaflet dealing with stoneware electric utensils manufactured by The Edison & Swan United Electric Light Co., Ltd. (Ponders End, Middlesex). These include boiling jugs, sterilising vessels, shaving pots, food warmers, and other domestic appliances. Prices are given for utensils to be used on all standard voltages from 100 to 250, and they are fixed at such a low figure as should encourage their wide adoption.

DISCOUNT TABLES.—A very neat and compact booklet entitled "Ediswan Discount Tables" is being distributed to the trade by The Edison & Swan United Electric Light Co., Ltd. (Ponders End, Middlesex). It contains various tables which are not to be found in ordinary discount books, such as 22, 24, 27, 32, 36, and 39 per cent., which are all useful in making up discounts on lamp prices.

Readers desiring copies of catalogues or pamphlets should apply to the firms in question, referring to the notice in "Electrical Engineering."

E.C.C. PLANT.—The Electric Construction Co., Ltd. (Dashwood House, 9 New Broad Street, E.C., and Wolverhampton), has issued a booklet entitled "Modern Electrical Plant," which has been compiled particularly for the foreign and colonial markets. It contains a large number of illustrations of the company's works and manufactures, and at the end there is a series of "Useful Notes and Formulæ, &c.," which will be found extremely useful in everyday work.

DIRECT COUPLED GENERATORS.—Leaflet No. 2, Catalogue No. 5, issued by T. W. Broadbent, Ltd. (Victoria Electrical Works, Huddersfield), describes in detail this firm's G type continuous current generator for direct coupling. This is constructed for heavy duty, and the commercial efficiency is put at from 92 per cent. to 94 per cent.

LOCAL NOTES

Batley: *Electricity Profits.*—The gross profit on the electricity undertaking last year was £4,037, as against £4,125 in the previous year, the nett figures after payment of capital charges being £298 in 1915-16 and £634 in the previous year. The cost of coal has increased from £2,709 to £3,353, but the Chairman of the Electricity Committee, in presenting the accounts last week, said the least satisfactory feature was that last year, for the first time since the undertaking was started, there was a slight decrease in the total number of units sold. The recent increase in price, however, enables an increased revenue to be shown.

Belfast: *An Inquiry Refused.*—As a result of the fatal accident to an employee in the Electricity Department a short time ago, a demand was made at the last meeting of the Corporation for a Government inquiry into the circumstances. Those members making it took the opportunity to revive the old charges of mismanagement in the Electricity Department, but they met with little success, and the proposal was negatived, the Coroner's jury having returned a verdict of Accidental Death: and the Home Office Inspector who was present not having raised any questions of this description.

Bradford: *Large Electricity Profits.*—In presenting the accounts of the electricity undertaking for 1915-16 at the last meeting of the Corporation, the Chairman of the Electricity Committee said that, with the exception of fuel, the works costs were less than in any previous year, not only per unit generated, but in actual cash, notwithstanding the increased output of five million units. The net profit was £15,989, after making £1,610 allowance to dependents of men who had joined the forces. Cost of coal showed an increase of £12,055, but a substantial proportion of this is met under the coal clauses in power contracts.

Colchester: *Electricity Deficit.*—There was a deficit of £881 on the electricity charges last year, and in order to improve the position a slight advance in charges is to be made.

Edinburgh: *Heavy Deficit.*—There was a deficiency on the electrical undertaking last year of £8,075. As mentioned in our report of the I.M.E.A. annual meeting, this is to be made good by increasing the rate of repayment of loans from twenty-five to thirty years for one year.

Finchley: *A Minimum Charge.*—Having regard to the diminution in the demand owing to the lighting restrictions and the Summer-time Act, the Council has put into force certain increased charges for electricity, with a minimum of 10 units in the summer and 20 units in the winter, for all private consumers. In bringing the matter before the last meeting of the Council the Chairman of the Electricity Committee reminded them that the Committee have the power to charge a minimum of 20 units per quarter at 8d. per unit.

Frome: *Street Lighting Account.*—Edmundson's Electricity Corporation have offered the Council a rebate of £235 on the street lighting account for last year, owing to lighting restrictions. The Council has declined to accept this, as it thinks the Company should allow half the contract price.

Glasgow: *Increased Revenue.*—Although the accounts of the electricity undertaking are not yet available, it is stated that the revenue for the year ended May 31st amounted to £540,720, compared with £405,372 in the previous year.

Halifax: *Higher Charges.*—The Electricity Committee recommend an increase in the charges for power supply of $17\frac{1}{2}$ per cent. from October 1st.

London: *Hampstead: Increased Charges.*—We recently mentioned that the Electricity Committee had recommended a further increase in the charges for current, making a total increase of 33 1-3rd per cent. since the war began. The Lighting Committee at the last meeting of the Council presented a lengthy report on the matter, from which it appears that there was a drop of revenue last year of £3,104, and a very decided further drop has taken place in the output from April 1st to date. It is anticipated that the income for the current year will fall at least £7,000 below the estimate, whilst there are prospects that the expenditure will increase to at least £5,430. Hence there was no alternative but to make the increase in charges already mentioned.

Luton: *Large Increase in Output.*—There was an increase in the output last year of nearly four million units, and in spite of the price of coal having advanced by 40 per cent. the total works cost per unit remains at 0·54d. The average receipt per unit has dropped to 0·86d., as against 0·91d. in the previous year, but the net profit has risen to £6,227 after reserv-

ing £700 for Excess Profits Duty. The Council has decided to charge against these profits various items of capital expenditure, such as house services, meters, railway wagons, &c., amounting to £2,155, and to allocate the remainder to working balance.

Rathmines: *Increased Charges.*—The charge for private lighting supplies is to be increased from 4½d. to 5d. per unit, and other forms of lighting are to be similarly increased by a ½d. per unit. Power and heating supply is to be increased from 1½d. to 1¾d. per unit.

St. Helens: *Increased Charges.*—The Council has agreed to an increase of 10 per cent. in the charges for electricity supply. In doing so, the Chairman of the Electricity Committee pointed out that St. Helens is one of the few towns in the country which did not charge meter rents. There has already been an increase of 10 per cent., and the further 10 per cent. will bring the price to 4¼d. per unit for private lighting. It is not without interest to note that the 3½d. rate which existed previously was passed when coal was at 6s. per ton, whereas now the Department is paying 21s.

Salford: *Employees with the Colours.*—The Electricity Department has 71 of its employees with the Forces. Unfortunately five of these have lost their lives, and four have been discharged from the Army owing to wounds.

Tunbridge Wells: *Electricity Profits.*—Notwithstanding that the price of electricity has not been raised, the nett profit on the electricity undertaking last year was £598. There has, however, been a decrease in revenue of £2,790.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Haslingden.—Under a pre-war arrangement, Haslingden has been supplied with electric current exclusively by Accrington, but the increased demand for current in both towns has made it difficult for Accrington to keep pace with the double requirement. In the circumstances, Accrington has concurred in Haslingden entering into an arrangement to obtain a supplementary supply from Rawtenstall, and the final negotiations have been concluded by the L.G.B. sanctioning an expenditure by Haslingden of nearly £2,000 for cables and switchgear, the charges upon which will, however, be largely borne by Rawtenstall. In case of need, Haslingden will thus be able to pass on a supplementary supply of current to Accrington.

New Zealand.—The Invercargill Corporation requires a steam turbo-alternator, with condenser and all auxiliaries. Tenders to Town Clerk, Town Hall, by September 28th.

This information is only of use to firms who can cable agents.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Wolverhampton.—Messrs. Willans & Robinson (Rugby) have received an order from the Corporation for a 5,000 kw. Zoelly turbine, running at 3,000 r.p.m., with Siemens generator, also for a surface condensing plant of their own manufacture, with Rees roturbo pumps, for use in conjunction with this turbine.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £126 to £130 (last week £130 to £133).

Liquidations.—The Naylor Battery Co. is being wound up voluntarily. The liquidator is Mr. H. Everett, 3-7 Southampton Street, Strand, W.C., and a meeting of creditors will be held at the Hotel Cecil to-day (Thursday) at 3 p.m.

APPOINTMENTS AND PERSONAL NOTES

The Loughborough Corporation require an engineer and manager for their electricity undertaking at a salary of £300 per annum. Applications to Town Clerk by July 24th. Mr. W. H. Allen's resignation was accepted at the last meeting of the Corporation, subject to any action on the part of the Board of Trade or Minister of Munitions, and also subject to the Council securing the services of a suitable successor.

Mr. B. Moynagh, of Dundalk, has been appointed assistant electrical engineer to the Dundalk Urban District Council, in succession to Mr. J. F. M'Entee, sentenced in connection with the recent rebellion.

An engineer is required, temporarily, as manager and secretary to an electric supply undertaking. (See an advertisement on another page.)

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

General Electric Co.—The net profits for the year March 31st, 1916, were £196,274 against £138,022, to which is added £36,701 brought forward, making a total of £232,976. After deducting debenture interest and depreciation there is an available balance of £205,716. A 10 per cent. dividend is recommended on the ordinary shares, the managing director's and employees' bonus amounts to £12,701, reserve is credited with £40,000, grants to dependants of men on active service absorb £12,962, and the balance to be carried forward to next account is £48,053. The result of the past year has been generally satisfactory. All the company's works have been fully occupied throughout the year, and have been mainly employed in the production of material essential for purposes of war. Although the demands on the company were mostly confined to the electrical field, many requisitions were made for appliances of entirely new types and patterns, and great difficulties had to be overcome. Some 1,500 experienced members of the staff and workpeople now serving at the Front had to be replaced by untrained substitutes. The capital expenditure on new works at Witton during the past year amounted to approximately £70,000. The extensions planned and referred to in previous reports have been suspended until the advent of a more favourable moment for carrying out such constructional work. For the same reasons, no further progress has been made with the Kingsway building. The export business of the company records very large inquiries, but, owing to well-known causes common to all exporters in this country at the present moment, only a small proportion of the demand can be filled. The directors draw attention to the increasing investment account, and think it desirable to make the following statement. The company's investments may be subdivided as follows:—(*a*) Manufacturing Companies: Peel Conner Telephone Works, Robertson Electric Lamps, Salford Electrical Instruments, Steel Conduit Company. The company is the distributing agency for nearly the whole of the output of these works, and has the control both as to financial interest and management. The Pirelli-General Cable Works, Ltd., is also a manufacturing company in which the General Electric Co. holds at present half the capital, the other half being held by Messrs. Pirelli and Co., of Milan. No profit has as yet been made, nor was it anticipated, as the works have only been running for a part of the year. (*b*) Trading Companies: Anglo-Argentine General Electric Co.; the British General Electric Co., Australia; the British General Electric Co., South Africa; General Electric Co. (of Belgium); General Electric Co. of China; General Electric de France; General Electric Co. (India). The object of these companies is to sell in their respective territories the products of the British works. The company is also interested in a number of electricity supply companies and sundry industrial investments. Mr. Montagu F. Armstrong, Mr. George H. Ide, and Mr. Maurice Solomon have joined the Board, and their appointment will be submitted to the shareholders for confirmation.

St. James' and Pall Mall Electric Light Company.—An interim dividend at the rate of 7 per cent. per annum on the preference shares and 5 per cent. per annum on the ordinary shares is announced for the June half-year.

County of London Co.'s Staff War Bulletin.—The number of employees of the County of London Electric Supply Co. was stated in error on p. 258 of our last issue as 74. This should be 300, the figure of 74 relating to the number of members who have joined the forces since the issue of the first bulletin.

ELECTRICAL ENGINEERING

The Engineering Journal of the Electrical Industry

With which is Incorporated

THE ELECTRICAL ENGINEER

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SUMMARY

Some further instances are given as to the manner in which British trade is handicapped by restrictions at the hands of railway, canal, and steamship companies. An interesting anomaly is that whilst a steam or gas engine weighing 21 tons might be carried for 80 miles for £14 3s. 6d., an alternator of the same weight would be charged £28 7s. (p. 276).

Although there was a deficiency of £73,795 on the working of the L.C.C. tramways last year, the fact must not be lost sight of that the strike involved a loss of revenue of over £100,000, whilst allowances to employees on war service were £95,364. The Manchester Corporation Tramways is able to contribute £100,000 to relief of rates (p. 276).

We reproduce an appendix to the Memorandum recently issued by H.M. Inspector of Factories explaining the electrical regulations applicable under the Factory and Workshops Acts. This deals with low and medium pressure switchboards, and details in considerable particularity methods to prevent accidents occurring (p. 277).

The annual report of the National Physical Laboratory shows that during last year practically the whole resources were utilised for Government purposes, with the result that few, if any, of the problems which it was intended to deal with during the year have been completed (p. 278).

A new list of reserved occupations has been issued, and we give the present position as it applies to men engaged in electrical industry (p. 278).

In our "Queries and Answers" Page this week the comparative merits of long- and short-shunt connected generators are discussed (p. 279).

Among the subjects of specifications published at the Patent Office last Thursday, were protective systems, telephony with balloons, motor control, and rotary converters. An application has been made to suspend an enemy-owned electrolytic patent (p. 280).

The General Electric Co. last year made a net increased profit of £31,000, and was able to allocate £40,000 to the reserve fund, and increase the carry forward by £11,000. An expenditure of £80,000 has been incurred on works extensions for war purposes, the bulk of the plant, however, being available for use after the war (p. 281).

The Sheffield Electricity Committee has been compelled to recommend an increase in charges for electricity. The whole financial position of the undertaking has been reviewed in a confidential report by Mr. S. E. Fedden (p. 282).

An expenditure of £1,500 is to be incurred at Derby for supplying a new factory (p. 282).

1st LONDON ENGINEER VOLUNTEERS

Headquarters, Chester House, Eccleston Place.
Orders for the Week by Lt.-Col. C. B. Clay, V.D., Commanding.

Officer for the Week.—Platoon Commander A. Gerard.
Next for Duty.—Platoon Commander W. J. A. Watkins.
Sat., July 22nd.—Instructional Class, 2.30, Coy.-Cmdr. Fleming.
Mon., July 24th.—Technical for Platoon No. 9, 46 Regency Street, S.W. Squad and Platoon Drill, Platoon No. 10. Signalling Class and Recruits.
Tues., July 25th.—Officers' Instructional Class, 6–7. Recruits, 7–8. Lecture, 7.15, "Telephones," illustrated by lantern slides, Mr. Wm. Aitken.
Wed., July 26th.—Platoon Drill for No. 2 Platoon.
Thurs., July 27th.—Platoon Drill, No. 6 Platoon. Recruits, 5.45–7.45. Instructional Class, 5.45.
Fri., July 28th.—Technical for No. 10 Platoon, 46 Regency Street, S.W. Squad and Platoon Drill, No. 9 Platoon.
Sat., July 29th.—Parade, 2.45, Headquarters, for Drill. Uniform.
Sun., July 30th.—Entrenching at Otford. Parade Victoria (S.E. & C. Ry. Booking Office), 8.40 a.m. Uniform, haversacks, water bottles. Midday rations to be carried. Railway vouchers will be provided.
August Camp.—A Camp will be held under canvas or in billets at Otford from July 29 to Aug. 31. For particulars see notice at Headquarters.
Unless otherwise indicated, all drill, etc., will take place at Chester House.

EDUCATIONAL NOTICES

The engineering courses at the City and Guilds Technical College, Leonard Street, Finsbury, includes electrical engineering, the professorship of which is at present vacant owing to the death of Prof. Silvanus P. Thompson, F.R.S. The training is adapted to the needs of various students, including pupils from secondary schools above the age of fifteen and young men who have previously served on a pupilage apprenticeship.

The Manchester Municipal School of Technology prospectus of its classes in all branches of engineering is ready. It gives particulars of the courses leading to the Manchester University Degree in the Faculty of Technology in eight branches.

The full course in electrical engineering at the Birmingham University, under Professor Robert Kapp, extends over four years. Mechanical and civil engineering courses may also be taken.

At Liverpool, the University has nine courses, including electrical engineering. The special matriculation examination or the entrance examinations must be passed to secure admission to the courses.

Further information is given in our advertisement pages.

Trade after the War.—The Prime Minister has appointed a Committee to consider the commercial and industrial policy to be adopted after the war, with special reference to the conclusions reached at the Economic Conference of the Allies, and to the following questions:—(*a*) What industries are essential to the future safety of the nation; and what steps should be taken to maintain or establish them? (*b*) What steps should be taken to recover home and foreign trade lost during the war, and to secure new markets? (*c*) To what extent and by what means the resources of the Empire should and can be developed? (*d*) To what extent and by what means the sources of supply within the Empire can be prevented from falling under foreign control? The Committee, whose chairman is Lord Balfour of Burleigh, will be assisted by the Chairman of the Board of Trade Committee, now investigating the position of the important industries of the country.

Linking-up in London.—A conference of electricity undertakings in the Western Metropolitan area was recently held, when the opinion was expressed that the time has arrived for concerted action to be taken regarding the future development of the undertakings. A Joint Advisory Engineers' Board has been formed.

HANDICAPS ON BRITISH TRADE

In the January issue of the *B.E.A.M.A. Journal* (Electrical Engineering, January 27th, p. 34), Mr. Frank Broadbent discussed some of the handicaps to which British export trade has been subjected at the hands of the railway, canal, and steamship companies. Considerable data bearing on these and other points were given by the B.E.A.M.A. witnesses to the Sub-Committee of the Advisory Committee of the Commercial Intelligence Department of the Board of Trade during the inquiry held in December last, and certain recommendations were made thereon.

The handicaps specified in the previous article had reference more particularly to export trade, but there are many others which apply equally to the home trade, and in the July issue of the *B.E.A.M.A. Journal* Mr. Broadbent returns to the subject and deals with it from this aspect.

The granting of special rates for export, whilst it has not yet become regularised in England to the extent it is in Germany, is in partial operation. In some cases the special export rates are given by the railways because of shipping competition, *e.g.*, from Manchester and Glasgow to London, and from Manchester to Southampton and Hull, whilst in other cases the special rates are on account of the large export trade carried on from particular manufacturing centres. There is, however, ample justification now for preferential rates being demanded from all the principal manufacturing centres to the principal ports, more particularly in those cases where the railway lines run right into the docks, as this eliminates cartage and minimises the amount of handling.

Many anomalies exist in the classification of machinery and apparatus which are included under the general term of electrical engineering, due largely to the fact that new apparatus has been called into existence which was not included in any of the original classes. Now that the size and weight of individual pieces tend to increase, the question of classification is becoming more and more serious. Heavy machinery, including agricultural engines, steam, gas, and oil engines, and hydraulic machinery, may be rated under what is called the "mileage" scale of charges instead of under the arbitrary rates charged from point to point for other machinery. Electrical machinery does not come under the mileage classification, hence in shipping a turbo-alternator the turbine may be charged at the mileage rate and the alternator at the ordinary machinery rate. The machinery rate, moreover, is not a level or fixed rate for all classes of machinery, but is subject to percentage additions, depending on the weight of single pieces.

It is important to observe how the electrical side of the industry is handicapped by the application of these arbitrary railway rates. Assume that a manufacturer wishes to despatch from his works an alternator of which the rotor weighs, say, 21 tons. If the ordinary machinery rate is 20s. the special rate for this weight would be 30s. per ton, or allowing a rebate of 3s. for cartage the net charge would be 27s. per ton. For an equivalent weight the rate on the mileage scale would be approximately half this amount, namely, 13s. 6d. Hence, whilst a steam or gas engine weighing 21 tons might be carried 80 miles for £14 3s. 6d., an alternator or part of an alternator of the same weight would be charged £28 7s.! This is by no means an extreme case, as for longer distances and heavier pieces the handicap on electrical machinery would be far greater.

Again, the question of packing in cases or in frames is one which needs revision. It is safer in many cases to bolt certain classes of machinery to stout frames rather than to pack same in frames or cases; that is to say, there is less risk of damage during transit when protected in this way. In the event of damage, however, it would be a debatable point as to whether or not the machinery was sent unpacked at owner's risk or in frames at companies' risk.

Another and a very serious handicap which the British manufacturer labours under when in competition with German shippers is the enormous advantage which the German manufacturer is able to obtain by means of the low through rates. Cases have come to the knowledge of the B.E.A.M.A. in which this has operated very harshly against the British manufacturer. In one case a British manufacturer having to ship about 500 tons of material to South Africa, including many heavy pieces of about 30 tons weight, was offered by the representative of a powerful German electrical combination special shipping facilities if he would ship his goods to Hamburg and then let them go through as part of a consignment from the German firm in question. This, as was clearly shown, would have effected a saving of about £750 in freight, notwithstanding the fact that the North German Lloyd's, who would carry the goods from Hamburg to South Africa, were in conference with the Union Castle Line, the British company operating from our home ports. Whilst it is clear that the German manufacturer can obtain special terms, it is quite possible that an examination of the books would show that the North German Lloyd's receive the full amount of the freight, the difference being made up in some way by subsidy from the German Government. The British manufacturer was prevented from availing himself of the advantageous rates offered by the fact that he would have thereby lost his 10 per cent. rebate on twelve months' shipping.

Another case, also concerning South Africa, is one in which a large quantity of machinery was specified, for which a British tender was the lowest, the amount involved being about £100,000 f.o.b. port of despatch. The representative of a German group induced the purchaser to call for fresh tenders c.i.f., with the result that the German offer was much lower than the British, and the work naturally went to Germany. It is pretty obvious what happened, namely, that the German company approached the Government, pointing out that there was a contract of £100,000 at stake and that a special through rate was necessary in order to secure the order for Germany. There is no doubt that this is what happens over and over again.

The foregoing are merely a few of the many points which the B.E.A.M.A. are taking up and placing before the Board of Trade Committee, with a view to some scheme being evolved which shall place the British manufacturer in a better position after the war than he has been hitherto.

Bearing on this matter we are informed by the secretary of the B.E.A.M.A. that certain alterations in classification, recommended by that body to the Board of Trade in 1914, will appear in the Board's annual statement for 1915, which will be shortly issued.

The new classification will be as follows:—

Import List.

Electrical goods and apparatus, etc.—Meters and measuring instruments; switchboards; unenumerated.

Machinery and parts thereof.—Electrical:—Generators and motors (except for aeroplanes, motor cars, and motor cycles); unenumerated.

Export List.

Electrical goods and apparatus, etc.—Meters and measuring instruments; transformers; switchboards; unenumerated.

Machinery and parts thereof.—Prime movers except electrical:—Other kinds:—Steam reciprocating engines; steam-turbine engines; internal-combustion engines (except for aeroplanes, motor cars, and motor cycles); unenumerated.

Electrical:—Railway and tramway motors; other generators and motors (except for aeroplanes, motor cars, and motor cycles); unenumerated.

ELECTRIC TRACTION NOTES

There was a deficiency of £73,795 on the working of the London County Council Tramways for the year to March 31st, 1916. This figure, however, must be read in conjunction with the fact that the tramway strike, which involved a loss of over £100,000, occurred in the second month of the financial year. There is a special charge of £10,000 for the removal of the old horse lines in Liverpool Road, and, in addition, War Service Allowances amounted to no less than £95,364. The deficit is to be met from general reserve fund. There is an estimated deficiency on the current year's working of £74,092, and the Highways Committee reports that it is considering the necessary steps to be taken to place the undertaking in a more satisfactory position, although attention is drawn to the abnormal circumstances under which the undertaking is at present working, and which render it impossible to draw any comparisons with previous years.

The Manchester Corporation Tramways show a net profit of £121,181 last year, of which £100,000 has been contributed to relief of rates and the balance placed to reserve, renewals, and depreciation account. This figure compares with £148,584 last year. Whilst the revenue exceeded that of 1913-14 (the pre-war year), the ordinary working expenses show an increase on the figures on previous years. The total expenditure is increased owing to the large payments made for War Service Allowances, &c., amounting to £92,808.

The net profit for the year on the Sheffield Corporation Tramways last year was £95,780, an increase of £25,841 over the previous year.

Telephone Notes.—An automatic telephone exchange has just been put into use at Paisley, this being the first of its kind in Scotland. The installation at present is capable of dealing with 1,200 lines, but the ultimate capacity of 2,500. The work has been carried out by the Automatic Telephone Co., under the direction, of course, of the engineering staff of the G.P.O.

LOW AND MEDIUM PRESSURE SWITCHBOARDS

We give below—in abstract—the Appendix to the memorandum by H.M. Electrical Inspector of Factories on the Electricity Regulations issued under the Factory and Workshops Act, referred to on p. 258 of our issue for July 6th.

It is sometimes overlooked that the term "switchboard" includes all classes of switchboards, from large station switchboards down to distribution fuse boards for lighting circuits and motor-starting panels. Mistakes, sometimes leading to serious accidents or involving somewhat extensive alterations, have been made by occupiers and others in not considering the conditions under which a switchboard is to be placed, particularly as to whether the conditions permit of the use of (*a*) an open type switchboard, *i.e.*, one having the conductors exposed, or (*b*) one enclosed in a cabinet which has to be opened for use, thereby exposing the live metal; or whether one having all live metal permanently protected is necessary.

Switchboards for use on systems to which Exemption 1 does not apply, i.e., *in which the pressure exceeds 125 volts alternating or 250 volts direct.*

The construction of fuse holders, which have to be handled whilst live, should be such that, in putting the fuse holder in or out of the board, (*a*) it is impossible for the hand inadvertently to touch any live part either of the fuse holder itself or of any adjacent live metal on the board, *e.g.*, the fixed contacts, and (*b*) the hand is screened from the flash should the fuse blow at the moment of being inserted.

All the regulations affecting switchboards are applicable. Thus, a switchboard, whether large or small, if it has bare conductors normally exposed so that they may be touched, must either be in an area set apart for the purpose, and to which only authorised and competent persons may have access, or it must be suitably fenced or enclosed. The alternative method of enclosing the switchboard in a cabinet is very commonly adopted, but even so, the conditions must be carefully considered. Even if enclosed in a cabinet, the door of which has to be opened for use, thereby exposing bare conductors so that they may be touched, there must be a clear and unobstructed working platform three feet wide. Whether in a cabinet or not, it must be so placed that all apparatus which requires handling is within reach from the working platform, and there must be an insulating stand. Large switchboards are generally placed where all the above conditions can be complied with without difficulty. Smaller switchboards, such as distribution fuse boards or motor panels, cannot, however, always be placed so as to comply with these requirements. Thus, distribution boards may have to be placed out of reach from the floor, so that there is no working platform, or they may have to be placed over iron floor plates or damp ground where an insulating stand is impracticable, or they may be on a works where they may have to be used by persons devoid of any technical knowledge.

Where the requirements referred to cannot be complied with, or where for any reason it is not convenient to comply with them, other means of safety must be adopted. There is no difficulty in this. Thus, Regulations 15 and 17 apply only to switchboards having conductors exposed or arranged to be exposed when live so that they may be touched. All that is necessary is to provide a switchboard having no conductors exposed or arranged to be exposed when live so that they may be touched. Such complete protection is provided in the case of certain distribution fuse boards. In others the protection provided is not entirely complete, but is such that it may be regarded as "adequate to prevent danger." Thus, all live parts are so protected that they cannot be *inadvertently* touched by a person handling the fuse holders, although it may be quite possible for him to touch them intentionally, as by putting a finger through an opening in the screen or guard provided for the entry of the contact of the fuse holder. As the responsibility for the adequacy of the protection provided rests with the occupier, he must take care in adopting such alternative means of safety that it is adequate. Switchboards constructed on such lines are now obtainable from a number of manufacturers, both for small distribution boards suitable for lighting circuits or larger ones for power circuits, but not all of those purporting to be in compliance with the requirements are adequately protected.

Similar protection of all live parts within the cabinet may also be necessary in the case of metal cabinets, even when placed within reach from an insulating floor of proper width. Thus, if the metal cabinet has a door hinged at the top, the operator has to hold the door open with one hand whilst handling the apparatus with the other, and he is therefore in connection with earth, despite the insulating stand. With a side-hinged door which can be opened 180° or thereabouts, there may be no need for this protection under these conditions, although it is often desirable, or the cabinet may be made of hard wood or other suitable insulating material.

Distribution boards enclosed in cabinets, but not otherwise protected (*i.e.*, having live metal exposed when the door is open), must be within reach of the ground or working platform, there must be a three-feet space in front and there must be an insulating stand. The cabinet should be preferably made of insulating material, but if of metal, the door must not be hinged at the top. For use under any other conditions there should be adequate protection of the live metal within the cabinet.

The question of accessibility of distribution boards, regarded merely from the point of view of convenience of operation, is often overlooked. It is not of great consequence in regard to boards containing fuses only and which require handling only occasionally, as when a fuse requires renewal or a circuit has to be made dead. If, however, they contain switches for controlling the branch circuits, it is obviously more convenient that they should be readily accessible. Whether containing switches or not, they should not be placed unnecessarily high up or otherwise inconveniently. To place them in positions involving danger to the attendant, as over running machinery or close to shafting, as is sometimes done, is contrary to the regulations.

Similarly, as regards convenience of operation, switches for controlling the branch circuits are better placed outside the cabinet, so that it is not necessary to open the door every time a switch has to be turned on or off. If, however, they are within the cabinet, convenience of operation is sometimes secured by the switch handles being extended through the base of the cabinet.

There are other types of completely protected switchgear, suitable for use under practically any conditions. Several firms make ironclad switchgear conveniently arranged, so that new panels can be added as required. With such switchgear, the requirements as to the fuses must be properly arranged for, and no live metal must be exposed in the fuse chambers, so that it may be touched inadvertently, when the fuse chamber is opened for renewal of a fuse. This may be arranged by the protection of all live metal within the fuse chamber and the use of properly protected switch-fuses; or by the fuses, and therefore all the conductors within the fuse chamber being on the dead side of the switch controlling the circuit, in which case safety is further ensured if the fuse chamber door is interlocked with the switch so that it cannot be opened until the switch is "off"; or by the use of properly constructed "fuse-switches." Where oil switches are used there must be means of making the oil switch dead for examination or repairs. In some, this is provided for by isolating switches, arranged to be operated from outside the casing, and in others by the oil switches being arranged on slides so that they can be withdrawn from contact with the bus-bars.

Totally enclosed ironclad switchgear for motor panels is now quite common. Here again attention should be paid particularly to the requirements as to renewal of the fuses.

Switchboards for use on systems to which Exemption 1 applies, i.e., *in which the pressure does not exceed 125 volts alternating or 250 volts direct.*

A number of the regulations do not apply in the case of such systems, and there is consequently greater freedom in the use of switchboards having conductors exposed or arranged to be exposed when live. At the same time it is definitely laid down in the regulations that safety shall be provided for. Thus, switchboards having live metal exposed, although not required to be in an area set apart for the purpose, should obviously not be placed where persons are liable to run into them or touch live metal in passing or where engaged in their employment. There are no specified requirements as to working platforms and passage-ways. Nevertheless, these should be of reasonable width, and where there would otherwise be danger of shock to earth, insulating flooring should be provided. Subject, however, to reasonable precautions being taken, open-type switchboards, motor starting panels, &c., are permitted without the full restrictions required in the case of those for higher pressures. The protection to be afforded will depend very much upon the particular circumstances of each case, and apart from the question of safety of employees, enclosed type switchgear may be necessary for the protection of the apparatus against damage. Enclosed type motor control panels are advisable in all cases where there is not plenty of space, and particularly where women are employed. Where machines, driven by motors, have starting panels attached or otherwise so placed that the workers are liable to touch them when in contact with earth, *e.g.*, laundry or printing machinery or machine tools, the switchgear should be of totally enclosed type.

Similarly, distribution fuse boards should in general be enclosed in cabinets. Fuses must be of such a type or so enclosed as to prevent scattering and must be so constructed that they may be readily renewed without danger. They must be so constructed that the hand is shielded from the arc or hot metal should a fuse blow on being replaced on the board on a short circuit. Unless the distribution board is placed where the person renewing a fuse is insulated from earth, either as regards the floor or by reason of the fuses being in a metal cabinet with which he may be in contact, the fuse holders must also be so constructed that there is no risk of touching live metal when handling them. The bus-bars and other live parts within the cabinet need not, however, be further protected. Similarly, if there are switches in the cabinet, so long as they have proper insulated handles no further enclosure of the parts is necessary. Again, distribution fuse boards need not be placed within reach of the ground if this is not convenient, but if they contain switches in addition it is much better that they should be placed within convenient reach.

THE NATIONAL PHYSICAL LABORATORY

THE report of the National Physical Laboratory for the year ending March 31st, 1916, records once again that the work of the Laboratory has been greatly affected by circumstances arising out of the war. A considerable part of the ordinary research work has been in abeyance, and in its place a large number of special investigations have been undertaken for Government Departments, whilst the testing work for the Government Departments has also very greatly increased. Two deaths have to be recorded among the members of the Laboratory staff serving with the Forces—viz., Mr. Donald Ewen, a junior assistant in the Metallurgy Department, and Mr. H. E. Barwood, a junior in the Thermometry Department. The total number of members of the staff now serving is 39, and the reduction as compared with last year is due to the fact that, owing to the importance of the work being carried out at the Laboratory, a number of the members who had voluntarily enlisted have been released from military service. Thanks are expressed to Sir Charles Parsons for a donation of £1,000 towards the Laboratory equipment. By desire of the Committee of the Privy Council for Scientific and Industrial Research, particulars have been laid before them as to various researches in which the Laboratory could be of assistance to British industries. The equipment of the Laboratory has been provided with special reference to such work, and during the past year help has been given to a number of firms who have undertaken the manufacture of goods formerly only obtainable from German sources. It is gratifying to be able to record that in several directions the efforts of these firms have been successful. We give below some extracts from the reports of the various departments.

In the Physics Department Mr. F. E. Smith records that most of the time has been spent upon work of a confidential nature, but the resistance standards have been compared from time to time, and a few new Weston normal cells have been set up and compared with older standards. An inductometer suitable for high frequencies, and having a wide range of self-inductance, has been constructed. The coils are flat, and their mean planes close to one another. The ranges extend from 0·2 to 35 millihenries. Three new vibration galvanometers of high current sensitivity have been built. Two of them are of high effective resistance, while the third is designed for low frequencies of the order of ten cycles per second and lower. Chiefly in connection with the testing of magnet steel, a considerable amount of work was done with a view to obtaining improved methods of testing the magnetic properties of bars, the determination of the remanence and the coercive field being particularly considered. Further progress has been made with the research on magnet steel, which is being carried out for the Institution of Electrical Engineers. Small rods of all the samples have been tested for their thermomagnetic properties, and curves have been drawn connecting the magnetic changes with the temperature. All these small rods (0·5 mm. diameter) have been chilled at their proper temperatures, and then tested for permeability, remanence, and coercive field. Similar magnetic tests have also been made on all the samples in their original form (thicker rods of 2·5 or 1·25 cm. diameter), and a certain amount of investigation has been made of various methods of chilling. The construction of the enclosed arc lamp for the production of high frequencies has been completed.

In the Electrotechnics Department, practically all ordinary research work unconnected with the war has had to be suspended, including the work on high efficiency standards of light for the unit of candle power. Some minor work in connection with telephone wire has been carried out for the Board of Inventions and Research, and there are at present two investigations regarding dry cells and accumulators in progress for the same body. The Tungsten arc lamp, made by the Edison and Swan United Electric Lamp Co., has been experimented with as a means of obtaining conveniently in the laboratory a source of considerable dimensions at the highest temperatures. Experimental lamps of larger size than the commercial patterns were placed at the disposal of the laboratory by the makers. The hot electrode instead of being a small sphere was a flat circular disc of about eight mm. diameter. This proved to be an extremely useful source of radiation for optical pyrometer work, and an apparatus has been constructed for use with the new method which promises to give very satisfactory results with great economy of time as compared with the use of furnaces.

The number of electrical measurements carried out during the year was 140, compared with 191 in 1915 and 259 in 1914, but the tests carried out in the electrotechnics division jumped from 5,080 in 1915 to 10,440 in 1916.

In the Photometry Division similarly there has been a large increase, the number of measurements in 1916 being 3,053 against only 410 in 1915.

In the Metallurgy and Metallurgical Department, in connection with the glass research, a special electrical plant has been installed consisting of a 50-kilowatt alternating current set, in which an A.C. generator giving 50 cycles at any desired voltage from 100 to 250 is driven by a three-phase A.C. motor working with current at 440 volts. This current supply is obtained from a three-phase static transformer, in which the 3,000 volt three-phase supply from the Twickenham power station is transformed down. A simple switchboard is provided for controlling the single-phase generator, and current from this machine is taken to a static transformer placed in the foundry adjacent to the furnaces. In this transformer the voltage can be reduced, in multiple steps, down to 7·5 volts, so that the use of currents as high as 6,000 amperes is provided for. Various types of electrical furnace are under trial and construction, in order to meet the various purposes for which they are to be used. Owing to the existing conditions the installation of the entire plant required for experimental work on optical glass on the scale contemplated has occupied a much longer time than had been anticipated, so that although most important preliminary work has been done no results can yet be described.

As owing to the war most of the energy of the staff during the year has been given to war work, few if any of the items in the programme of work for 1915–16 were completely dealt with. Thus the programme which appeared in the report for last year still stands. Among other things, it is hoped to make good progress with the research into the temperature of buried cables undertaken in connection with the Institution of Electrical Engineers, for which a grant has been received from the institution and from the Research Committee of the Privy Council, as already mentioned in our columns.

CERTIFIED OCCUPATIONS

A REVISED list of certified occupations has just been issued in which a few modifications have been made compared with the list which we noticed on page 211 of our issue for June 8th. It still provides, however, that all classes of workmen, single or married, employed in electrical generating stations, including those for tramways and electrical railways, are exempt from military service, irrespective of age. On tramways, the traffic inspector, chief storekeeper, parcel superintendent, and drivers are exempt if they are over thirty years of age and single, but the age limit does not apply to married men. In connection with electric accumulator manufacture, departmental managers and foremen of thirty years and upwards are exempt if single men, whilst casters, mixers, pasters, lead burners, forming men and battery workers are exempt if single and over twenty-five years of age. Married men of all ages are exempt in both classifications. A new class is included in the list, namely, electricians or electrical fitters engaged in the maintenance or repair of electrical, medical, or surgical apparatus at hospitals (including nursing homes), and married men twenty-five years of age and upwards are exempt. Only single men over forty-one years are exempt. Departmental managers and foremen engaged in mica manufacture for electrical or scientific appliances are exempt if over thirty years of age, and mica machine workers if over twenty-five years of age, these figures applying to single men. All married men are exempt. Electricians or electrical fitters engaged in the maintenance or repair of motors and other electrical plant in factories are exempt over thirty years of age and single, all married men, irrespective of age, coming within the reservation. Electricians engaged in the coal mining industry are exempt, single or married without age limit and whether working above or below ground.

The regulations and instructions issued with the list provide that when exemption is claimed for a man on the ground that he is in a certified occupation, he is entitled without further question to a certificate of exemption if the Tribunal are satisfied that his principal and usual occupation is a certified occupation. The military representative, however, may ask the Tribunal to consider the question whether, notwithstanding that the man is in a certified occupation, it is necessary to retain him in civil employment. The Tribunals are also instructed to apply the reservations having regard to the fact that skilled mechanics are from time to time required to complete the establishment of an Army workshop in the field or of a unit. The age limits given are in all cases meant to refer to April 4th, 1916, *i.e.*, men who had not reached the ages stated on April 4th, are not covered and do not become covered by reason of having subsequently attained the specified age. Men who on November 2nd, 1915, were unmarried or widowers without any child dependent on them will be treated as single men. At the same time, any man employed in the occupations contained in the list, irrespective of age or whether he is single or married, may be treated by the Tribunals as being in a certified occupation if he has been certified not to be fit for general service. On the other hand, with a few exceptions, men employed in the occupations named in the list are only covered if they can show that they were engaged in the same occupation on or before the date when the National Register was made, namely, August 15th, 1915. No man whether attested or unattested, so long as he rightfully holds a certificate in connection with a War Service Badge on whatever date it was issued and whether he still holds a badge or not is liable to be called up for service with the colours.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,503.

It was desired to test two shunt-wound interpole dynamos by the Hopkinson method, with separately excited shunts. It was found impossible to get them running steadily, for as soon as the "dynamo" field was slightly weakened to increase the loading of the combination, the current and speed rose very rapidly. Explain cause and remedy.—NOMAD.

(Replies must be received not later than first post, Thursday, July 27th.)

ANSWERS TO No. 1,501.

I have recently had to deal with an 80-volt, 100-ampere, 4-pole, C.C. dynamo driven by a petrol motor. The diagram of connections shows the machine connected up as a "short shunt," but it is actually connected as a "long shunt" machine. It is considerably over-compounded, and a shunt field regulator marked "regulation 3 to 5 amperes" is provided. What difference in regulation, efficiency, safety, &c., is there between the two ways of connecting up the shunt winding? Which is the more usual method, and why?—I. W. T. K.

The first award (10s.) is made to "Arc" for the following reply:—

The only difference between the two methods of connection mentioned in the question is that with a "short shunt" the current through the series winding is the output current of the machine; whereas with a "long shunt" the shunt current as well as the output current flows round the series coils. Since the shunt current is small in comparison with the full-load current, the alteration in the characteristics of a dynamo due to changing from one method of connection to the other is generally inappreciable. This will probably be best understood by considering the approximate figures for an 8-kw. dynamo. Suppose the ampere-turns per pole required to give the rated terminal voltage at the correct speed be 2,200 on no-load and 3,000 on full-load. The excitation loss at full load is probably about 240 watts in the shunt and 110 watts in the series winding. With a short shunt the resistance of the series coils is then $\frac{110}{100 \times 100} = \cdot011$, and the voltage drop across them at full load is 1·1 volts. Let us also assume the shunt regulator to be dissipating 30 watts: so that the total power lost in the shunt circuit is 270 watts, whilst at full-load the pressure across it is $80+1\cdot1=81\cdot1$ volts if the machine maintains exactly the same terminal voltage on full-load as on no-load. Hence the shunt circuit is $\frac{270}{81\cdot1}=3\cdot33$ amp.

On no-load, however, the shunt current (with constant shunt resistance) becomes $3\cdot33 \times \frac{80}{81\cdot1}=3\cdot28$ amps., so that the number of shunt turns per pole is $\frac{2,200}{3\cdot28}=670$. The shunt ampere-turns per pole increase to $670 \times 3\cdot33=2,230$ on full-load. Consequently the series turns per pole $=\frac{3,000-2,230}{100}$ $=7\cdot7$; say, 8 turns, makig the actual ampere-turns per pole on full-load $=2,230+800=3,030$.

Next, consider the same machine—with its shunt regulator unaltered—connected long shunt. The shunt current of 3·28 now flows round the series windings, so that the total ampere-turns per pole on no-load $=(670+8)38=2,226$; and those on full-load $=2,200+8 \times 103\cdot28=3,026$. Again, the power expended in the shunt circuit is $3\cdot28 \times 80=262$, and that in the series winding is 117, making a total excitation loss of 379 watts. The above figures can be tabulated thus:—

	Short shunt.	Long shunt.
No-load ampere-turns	2,200	2,226
Full-load ampere-turns	3,030	3,026
Full-load excitation loss	380	379

From this table it is clear that merely changing the shunt connection—everything else being left unaltered—does not change either the regulation or the efficiency to any appreciable extent, so that the over-compounding referred to in the question cannot be due to the cause suggested.

The short shunt is probably more common than the long shunt, though the writer has come across machines by the same firm, some connected one way and some the other. It is mainly a matter of convenience in connecting the shunt winding; one end of the latter is almost invariably joined to one set of brushes, otherwise it has to be brought out to the terminal board. If the series winding happens to be connected on that side of the armature winding, the dynamo becomes a short shunt. On the other hand, if the series coils are on the side of the armature to which the lead from the shunt regulator is joined, then it is entirely a question of convenience whether that lead is connected to give a short or a long shunt.

The extent to which a dynamo compounds can be decreased in one or more of the following ways:—(1) By connecting a diverter in parallel with the series winding and adjusting its resistance to give the desired compounding. (2) By shifting the brushes forward. This is a very effective method with inter-polar dynamos, since little sparking trouble is then experienced. (3) By increasing the length of the air-gap under the main poles, so as to increase the shunt ampere-turns in comparison with those due to the series coils. This method is limited by the heating of the shunt winding, and by the extent to which the shunt current can be increased by cutting out some or all of the regulating resistance. (4) By running the set at the minimum speed practicable, and consequently working with a stronger shunt. This is also subject to the limitations mentioned in (3).

The second award (5s.) is made to "Koil" for a reply which we have abridged:—

Long and short shunt connections for compound-wound dynamos are about equally good, neither showing any marked advantage over the other. In practice preference seems to be given to long shunt connections, and the following points indicate the reasons for this: (1) Both ends of the shunt winding are easily accessible for separate excitation, &c., (2) Unless an equaliser or equivalent terminal be fitted in short shunt connected machines, the shunt regulator must always be on the opposite pole to the series winding. This is sometimes objectional—*e.g.*, in the case of some "single-wired" installations. (3) Calculations for long shunts are somewhat easier than for short shunts, as the voltage across its terminals are constant (if the machine is level compounded) and does not depend upon the voltage drop in series winding.

The effects on efficiency, regulation, and compounding due to changing from short shunt to long shunt are practically negligible. It is not likely that the considerable over-compounding obtained is due to the connections of the shunt, and it is suggested that one or more of the following remedies be tried: (1) More brushes forward; (2) reduce speed at full load, and obtain increased excitation by cutting out more shunt resistance; or (3) connect a "diverter" resistance in parallel with the series windings and adjust until correct compounding is obtained.

"Koil" also gives a typical calculation similar to that given in the first answer.

QUESTION 1,500.—In a reply submitted too late for publication last week, Mr. A. E. Gott suggests that the reversal of polarity of the machine may have been due to the workman reversing the relative positions of the insulating and conducting bushes which are between the brush spindles and the cross-connecting rings.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published July 13th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

7,457/15. **Protective System.** W. H. COLE. A system of electrical distribution comprising means of producing under normal working conditions a potential difference between the two parts of a longitudinally-divided feeder at all points between the extremities, without, however, producing a difference of current flow whereby when a fault develops involving both members current will flow from one to the other, thus causing the unbalanced conditions which result in disconnecting the conductor from the system. (Five figures.)

8,826/15. **Telephony with Balloons.** C. BARDELONI. A system of open circuit telephonic communication with captive balloons, in which the earthed mooring cable acts as the line conductor, and is provided with an electrostatic "counterpoise" at the end. The receiver is placed in circuit with an ionised gas relay. (Four figures.)

11,768/15. **Motor Control.** B.T.-H. Co. (*G.E. Co., U.S.A.*). A series-parallel system of control of a plurality of series wound motors in which they are first reversely connected in series with full field. A bridge connection is then established to intermediate points in the fields and the bridged portion of the fields are open-circuited, the disconnected portions being utilised to establish a parallel arrangement of the motors and the bridge connection opened, and finally the field tapped at intermediate points to give a reduced field current for parallel running. (One figure.)

16,933/15. **Rotary Converters.** O. H. PIEPER and A. F. PIEPER. In a rotary converter the combination with an armature having an ingoing D.C. conductor and an outgoing A.C. conductor of a speed-controlled switch carried by the armature and arranged in series with the A.C. conductor, serving to open and close the A.C. circuit automatically according to the speed of the armature as determined by the D.C. circuit. (Two figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: MACKAY [Arc lamps] 12,994/15.

Dynamos, Motors, and Transformers: LANGDON-DAVIES, SOAMES, and NAAMLOOZE VERMOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ [Dynamo drive] 9,282/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Cast squirrel cage rotors] 9,557/15, and [Motor-control systems] 9,836/15; RAILING and GARRARD [Rotary converters] 15,681/15.

Ignition: GUINESS [Sparking plugs] 13,088/15; JOLY [Sparking plugs] 13,733/15; L. RENAULT [Automatic timing] 1,765/15; J. W. MILLER and M. COLLARD [Magnetos] 5,085/16 (100,713); F. F. BAUMAN [Dry Battery] 6,042/15 (100,714).

Switchgear, Fuses, and Fittings: BERRY and MARKHAM [Armour-clad switches] 7,979/15; HARLOW [Reactance coils] 10,330/15; GENERAL ACCESSORIES Co. (*Rosenthall and Seymour*) [Adaptors] 15,460/15; BEGG [Switch-plug] 15,922/15; BENNETT [Lampholders] 16,349/15; IGRANIC ELECTRIC Co. (*Cutler-Hammer Mfg. Co.*) [Controllers] 1,245/16 (100,703).

Telephony and Telegraphy: BRITISH INSULATED & HELSBY CABLES, LTD. [Telegraph system] 8,712/15; RELAY AUTOMATIC TELEPHONE Co. & BYGRAVE [Selectors] 9,345/15; AUTOMATIC TELEPHONE MFG. Co., SAVIN and SMITH 15,539/15.

Traction: PIEPER [Mixed petrol-electric drive] 29,825/13; C. F. KETTERING and W. A. CHRYST [Engine starters &c.] 4,688/16 (100,228).

Miscellaneous: SHORTT [Electric clocks] 9,527/15; BRÖNSTED, and HELLESENS, L. ENKE, & V. LUDVIGSEN [Mercury oxide battery] 9,684/15; SCHNEIDER & Co., ELEKTRICITÄTS GES. [Pocket lamp] 15,863/15; E. A. GRAHAM and W. J. RICKETTS [Apparatus for the observation and electrical transmission of azimuth angles] 1,390/15 (*100,704*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Electro-chemistry: SIEMENS & HALSKE A.G. [Electrolytic apparatus] 8,111/16 (*100,739*).

Ignition: C. T. MASON [Ignition dynamos] 8,584/16 (*100,742*).

Instruments: LANDIS & GYR [Variable-rate meters] 8,558/16 (*100,741*).

Switchgear: SIEMENS & HALSKE A.C. [Relays] 6,541/16 (*100,732*).

Traction: C. F. KETTERING and W. A. CHRYST [Electrical engine starters, &c.] 8,794/16 (*100,747*).

Miscellaneous: J. BERGONIE [Surgical electro-magnet] 8,792/16 (*100,746*).

Suspension of Enemy Patents

11,693/10. **Electrolysis.** J. BILLITER. An application by E. J. Smith for the avoidance or suspension of the enemy-owned patent will be heard on July 20th. The specification describes details of constructions of electrolytic cells for the preparation of hypochlorites.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: H. W. HANDCOCK, A. H. DYKES, and R. T. SMITH [Conduit system with tubes of brass or copper soldered into junction boxes] 7,555 and 7,557/07.

Electrometallurgy and Electrochemistry: H. NATHUSIUS and THOMASPHOSPHATWERKE GES. [Electric steel furnaces] 7,188 and 7,923/08.

Telegraphy and Telephony: C. TURCHI and E. BRUNÉ [Simultaneous telephony and telegraphy] 7,585/03.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"Electrical Engineering: First Course." By E. J. Berg and W. L. Upson. 416 pp. 9¼ in. by 6¼ in. 296 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 17s. net.

"Large Electric Power Stations. Their Design and Construction." By G. Klingenberg. 260 pp. 10 in. by 7½ in. 173 figures and 7 plates. (London: Crosby Lockwood & Son.) English translation. 25s. net; abroad, 26s.

N.E. Railway Directory of Manufacturers.—We have received a copy of the 1916 Directory of Manufacturers, Wholesale Importers and Exporters on the North-Eastern Railway Co.'s System. This is the third edition of this volume, and it contains some 36,000 entries, split up under more than 1,200 separate trade headings. These figures show an advance on the previous two editions, and the value of the entries has been enhanced by the inclusion of telegraphic addresses and telephone numbers. It is interesting to note that some 15,000 copies of the volume are being distributed, not only to traders throughout the country, but to His Majesty's Consuls all over the world and to British, Colonial, and Foreign Chambers of Commerce.

Enemy Firms Wound Up.—The Board of Trade has made orders for the winding-up of the following firms:—Plutte, Scheele, & Co., Ltd., 18/19, Queenhithe, E.C., merchants and agents for electrical goods. Controller, G. W. Roberts, 133 Wool Exchange, Coleman Street, E.C.; the A.E.G. Electric Co., Ltd., and the A.E.G. Electric Co. of South Africa, Ltd., Caxton House, Westminster, S.W. The controller in both cases is Mr. Maurice Jenks, 6 Old Jury, London, E.C.

"ARORA" ELECTRICAL APPLIANCES

SOME interesting electrical appliances are described and illustrated in a new catalogue issued by the Arora Co. (Loughborough, Leicestershire). Fig. 1 below shows a three-section boiling plate which has been designed to meet the demand for rapidity in boiling. The cast-iron frame is specially shaped so that it will not crack under stresses caused by the heat. A heavy fire-clay disc retainer supports three independent

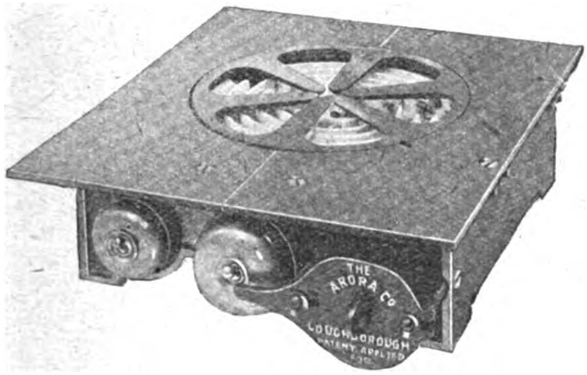

Fig. 1.—Arora Boiling Plate.

sector-shaped heating elements, any one of which can be replaced almost as quickly as changing a lamp in its socket. The boiler can be controlled to give four "heats," from full heat to a gentle heat for simmering purposes. The power consumption is only about one-half unit per hour for each sector.

In Fig. 2 is illustrated an "Arora" Electric Fire with three fire bars. One switch controls two bars, and a separate switch the remaining bar. The fire shown is 19 inches high and 21

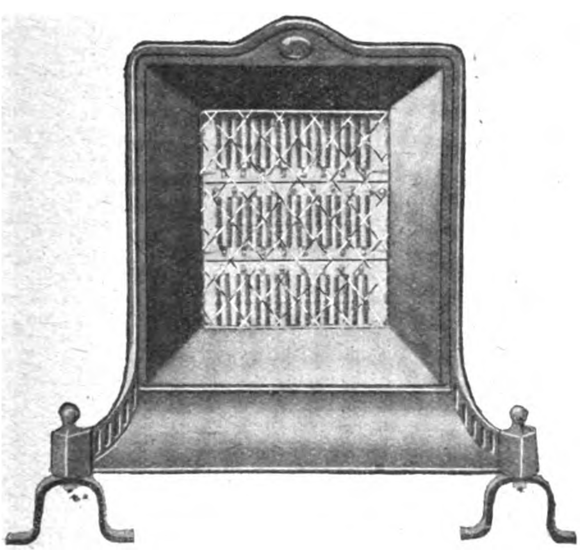

Fig. 2.—Arora Electric Fire.

inches wide, and has a weight of 23lb. They are stocked for six voltages, 200v. to 250v. inclusive.

An electric grill is also illustrated in the catalogue, made of cast-iron, with an aluminium finish. It is so constructed that the electrical part is easily lifted away, allowing the rest of the grill to be thoroughly washed without any risk of damaging the electrical elements, this arrangement presenting a very useful and novel feature. Grills are stocked for all voltages from 200v. to 250v. and also 100v. to 120v. inclusive.

THE G.E.C. ANNUAL MEETING

IN his speech at the annual meeting of the General Electric Co., Ltd., on Monday (the accounts were given in our last issue), Mr. H. Hirst said the outstanding features of the balance-sheet were a nett increased profit of nearly £31,000, an expenditure, roughly, of £80,000 in works extensions; that the company had been able to do increased business, and yet keep the large sum of £252,000 invested in War Loan and Treasury Bills; and, finally, that the proposed appropriation provided for an increase to the reserve fund of £40,000, and an increased carry-forward of £11,000. The distribution on the Ordinary shares viz., 10 per cent., was the same as last year. Dividends absorbed a slightly larger amount, namely, £92,000, instead of £87,000, and grants to dependents of men on active service (men who, at the outbreak of war, voluntarily enlisted) reached a total of £12,960, an item which he was sure the shareholders would heartily approve. The advance shown was all the more remarkable as a great portion of the previous year's output was for Government requirements, and the prices charged were, almost without exception, the same as those ruling prior to the war. The higher profits were mainly due to the fact that under present conditions there had been more repetition work than in normal times, and some manufacturing departments which, under pre-war conditions, showed an annual loss, under present conditions yielded a legitimate profit. The large reserve stock of standard lines had naturally benefited by the general rise in prices, and this had been a contributory factor to the success of the year. Above all, the results were mainly due to the loyalty, co-operation, and resource of the staff and the majority of the workpeople. A goodly number would not be lured away into the many concerns started since the war, which temporarily are offering such tempting and abnormal wages, and such expressions of loyalty had been much appreciated by your directors.

Continuing, the chairman said this was not a time for thinking of larger dividends. With the ever-increasing difficulty of obtaining raw material, the probable further diminution in the supply of labour, and the necessary limitation to imports and exports, it was impossible to forecast what surprises might be ahead of us before the war is over. It must be borne in mind that a big task confronted the electrical industry in this country. Much was expected of it, and the General Electric Company were anxious to fulfil these expectations. As soon as there was the slightest indication as to what would be the Government policy after the war, and in what way new enterprises would receive the necessary measure of Government assistance which present conditions demand, they would be willing to open up in new fields and avenues which have hitherto been closed to the manufacturers of this country. The shareholders would be interested to learn that through one of the associated companies, the Peel Corner Telephone Works, a magneto factory had been established near Coventry, and Government contracts had already been secured.

Conditions of war made it impossible to discuss fully and thoroughly all the various operations in which the company was engaged, but he could assure the shareholders that if, after the cessation of hostilities, this ban was removed he would be able to tell such a story of "G.E.C." war activities as might well fill both the shareholders and staff with pride. Finally reference was made to the fact that no fewer than 52 G.E.C. men had been killed in the war, 133 have been wounded, 61 have been invalided, and four are either missing or prisoners of war; indeed a heavy casualty list out of a total of 1,500 who have joined the forces.

The report and accounts were then put to the meeting.

Mr. Walker, a shareholder, speaking with regard to the £80,000 spent on extensions, asked as to the position with regard to this after the war, as the expenditure was apparently for war purposes.

The Chairman said this matter was not one of great moment to the company, as practically all the machinery could be utilised for the ordinary purposes of the company later on.

Cardiff and the Summer-Time Act.—We have received from the City of Cardiff Electric Light and Tramways Department load curves showing the effect of the Summer-Time Act in reducing the power station loads. These are similar to the ones we have reproduced in recent issues, and show clearly the effect on the generating stations. Two sets of curves are given, one for the Hayes sub-station—a rotary sub-station dealing with the requirements in the centre of the city—and one for the single-phase system which is principally lighting. There are two curves for each station, one showing the effect of the Restricted Lighting Order in April, and the other the effect of the Summer-Time Act in May. It is difficult, however, to estimate the full effect of this legislation, as the public lighting in the city had already been considerably reduced in September last for economical reasons. From figures obtained, it appears that the drop in load on the single-phase system due to the Restricted Lighting Order was about 11½ per cent., and due to the Summer-Time Act a further 8½ per cent.

University College Awards.—The following awards have been made in the Faculty of Engineering at University College:—Archibald P. Head Medal and Prize, K. C. Chakko; Jews Commemoration Scholarship, P. S. J. Bovey; Andrews Second Year Scholarship (Mathematics and Science), T. C. Barker; Engineering Diplomas, L. M. F. Barrett (Civil and Municipal), K. C. Chakko (Civil and Municipal, with distinction), A. I. Jenkins (Civil and Municipal), N. A. Khot (Mechanical), H. M. A. Rahman (Civil and Municipal), M. A. Rashid (Civil and Municipal), B. H. Ung (Civil and Municipal).

LOCAL NOTES

Hull: *Electricity Profits.*—There was a net profit of £4,247 on the electricity undertaking last year, which has been carried to reserve. In common with other East Coast supply undertakings, the department has been temporarily adversely affected by the lighting restrictions, this portion of the revenue showing a decrease of £5,000 on the previous year, or £6,200 on the last pre-war figures, notwithstanding an increase of 307 in the number of lighting consumers. On the other hand, the increase in revenue from power amounts to £9,517, or 22 per cent. over last year's figures. The reserve fund now stands at £20,500, or slightly over 7 per cent. on the outstanding loan debt. The Electricity Committee regrets, through his unanimous election to the chairmanship of the Finance Committee, the loss of its Chairman, Alderman E. Hanger, J.P., whose progressive policy, business knowledge, and tact have been of great service to the undertaking. Throughout his ten years' chairmanship he has been ably seconded by his deputy, Councillor J. Pybus, who now succeeds him in his former position.

Islington: *Electricity Accounts.*—The units sold last year reached the record figure of over 8½ millions, of which more than a half was for power, the supply for this purpose having increased by more than one million units. Lighting naturally has shown a further decrease, but Mr. Albert Gay, the Borough Electrical Engineer, believes he has reached the rock-bottom effect of the war conditions upon this class of consumer, and that during next year, new business should more than counterbalance the decreased sales due to the present lighting restrictions. Notwithstanding that the price of coal increased from 9s. to 10s., the total works costs have only increased by 0·12d. per unit. After meeting capital charges, there is a balance of £2,117, which has been carried to reserve fund. There were 1,293 motors connected with the mains on March 31st, giving a total of 6,975 h.p., whilst applications are in hand for a further 1,766 h.p.

Oldham: *Electricity Accounts.*—There was a net profit of £5,017 on the working of the electricity undertaking last year. The number of units sold was 5,385,229, an increase of 2,606,079.

Sheffield: *Position of the Electricity Undertaking.*—An important report has been presented to the Corporation by Mr. S. E. Fedden, the General Manager of the electricity undertaking, in which he deals with the whole position from the financial point of view. Although the report appeared in the minutes of the meeting at which the matter was discussed, we are informed by Mr. Fedden that it was a confidential document, and that it has been expunged from the minutes. A proposal that from the September readings all accounts for the supply of electricity should be increased by 10 per cent. where the present price is more than 2d. per unit, and 20 per cent. where the price is 2d. per unit or less, has been postponed until August. Mr. Fedden points out that the cost of generation during the current year will be £119,601 more than the pre-war figure. The increased cost of coal already contracted for is some £70,000, and an increase of £16,000 on the further supply that will be required is anticipated. The cost of machinery contracts has gone up to such an extent that the department is now paying £62,500 more as compared with prices obtaining immediately before the war, this representing increased capital charges of £5,000 per annum. The most important part of the report dealt with periods of repayment and the possibility of plant becoming obsolete before it was paid for, and also the necessity for maintaining a reserve fund up to the full 10 per cent. authorised by the Electric Lighting Acts was urged upon.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The Sydney office of H.M. Trade Commissioner in Australia reports that, on the motion of the State Minister for Public Works in the New South Wales House of Assembly, the Public Works Committee of the State has been requested to report upon the expediency of carrying out schemes of hydro-electric development in various districts of New South Wales. The estimated cost of each of the schemes is as follows:—Snowy River scheme, £5,000,000; Shoalhaven River scheme, £770,000; Tumut River scheme, £600,000; Cataract Cordeaux scheme, £306,800; Burrenjuck Dam scheme, £100,000; Gilmore Creek scheme, £44,400; and Nymboida River scheme, £35,000. The power-house proposed to be constructed in connection with the Snowy River scheme is to have generators capable of generating 750,000,000 units per annum. In connection with the Gilmore Creek scheme an electric railway from Gilmore to Batlow is proposed to be constructed at an estimated cost of £160,500.

A copy of the official report of the discussion on the above schemes, which contains details of the works proposed to be carried out, may be consulted by United Kingdom firms at the Commercial Intelligence Department of the Board of Trade, 73, Basinghall Street, London, E.C.

Derby.—An expenditure of £1,500 has been sanctioned in connection with the supply to a new works about to be erected.

Islington.—The Finance Committee of the L.C.C. recommends sanction to a loan of £1,500 for mains and switchgear.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Bristol.—The Corporation has accepted a tender of Messrs. Fraser & Chalmers for a 3,000-kw. turbine with Vickers alternator and Westinghouse condensing plant at an inclusive sum of £11,608.

Luton.—Mr. W. H. Cook, the Borough Electrical Engineer, has reported upon the necessity for new plant, having regard to the fact that there is practically no standby in the boiler-house, and that he anticipates an increased demand of over 1,500 kw. next winter. It has been extremely difficult to obtain reasonable quotations for the plant required owing to the unsettled state of the market, but the following tenders have been received, and a recommendation to accept them was adopted at the last meeting of the Corporation. The Ministry of Munitions has sanctioned the plant under Class "A," which gives priority over all work in other classes in hand by the manufacturers:—Two boilers and stokers, Clark, Chapman & Co., £7,648; economiser, E. Green & Sons, £1,091; coal-weighing machines, W. T. Avery, Ltd., £440; water softener, Harris Anderson Patent Feed Water Filter Co., £455; rotary feed pump, Hayward, Tyler & Co., £258. Application is to be made to the Local Government Board for the necessary loan.

APPOINTMENTS AND PERSONAL NOTES

All friends of Major W. A. Vignoles, Borough Electrical Engineer at Grimsby, will wish him a speedy recovery from the wounds which he has received whilst in France with his battalion. He is now in a London hospital with two fingers of his left hand fractured.

The Birmingham Electricity Department invite applications for a senior shift engineer. (See an advertisement on another page.)

An engineer is wanted as secretary-manager of an electric supply undertaking. (See an advertisement on another page.)

The Thames Paper Co., Ltd., require two good electricians. (See an advertisement on another page.)

Another of the staff of Callender's Cable Construction Co. has met his death at the front, Second-Lieut. F. R. Hoggett, A.M.I.C.E., dying on Tuesday of wounds received in the great offensive.

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £120 to £124 (last week £126 to £130).

War Tribunals.—Exemption has been granted till September 30th for three engineers on the staff of the Macclesfield Electricity Supply Co.

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The Engineering Journal of the Electrical Industry

With which is Incorporated

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SUMMARY

A NUMBER of books are reviewed on p. 284.

THE successful use of isolating transfomers, in some cases of 1-to-1 ratio, for preventing widely separated grounds on different phases affecting the entire system of a power supply company, has been described before the American Institute of Electrical Engineers by Mr. O. O. Rider (p. 284).

SOME interesting information is given as to the preparations which are being made in Germany to deal with trade after the war. Among other things, the six leading engineering societies have amalgamated (p. 285).

TESTS have recently been made by the research division of the Massachusetts Institute of Technology on the properties of various types of roadway in respect of their suitability for traction. Because of its power-measuring capabilities, an electric vehicle was used in making the tests (p. 285).

OUR "Questions and Answers" page this week has reference to difficulties met with when trying to run a small d.c. generator as a motor (p. 286).

AMONG the subjects of specifications published at the Patent Office last Thursday were petrol-electric traction, a.c. motors, reactance coils, and tungsten arc lamps. A wireless telegraph patent has been granted in spite of opposition. A patent for a filament stem manufacturing machine expires this week after a full life of fourteen years (p. 287).

SOME figures are given of the advantages obtained with the use of an electric street watering van at Blackpool.—Attention is drawn to the opportunity for increasing the use of electric vehicles, especially for commercial purposes, owing to the stringent restrictions that are being placed upon the supply of petrol (p. 288).

A PAPER on "Oil Engines and Steam Engines in Combination" was read on June 23rd, before the Diesel Engine Users Association by the President, Mr. Geoffrey Porter. The author dealt with the problem met with in extending certain small inefficient steam plants, and showed the advantages of the adoption of Diesel engines (p. 288).

WE publish some notes from a semi-official German organ with reference to the German administration of telegraphs and telephones in Belgium. The systems in all the large towns are said to have been in working order a short time after the German occupation. Private telegraph traffic has developed favourably, but private telephone traffic is not "yet" permitted (p. 289).

ILLUSTRATED articles deal with the control of small d.c. motors and starters for induction motors (pp. 289 and 290).

BATTERSEA and Fulham power-houses are now linked up.—Further municipal accounts are dealt with, and the point is again strongly emphasised that power supply has saved the situation in many cases (p. 290).

MAINS extensions are to be carried out at Poplar, new plant is required at Bradford, and an overhead electric crane by the New South Wales Railway Commissioners (p. 291).

DR. W. H. ECCLES has been appointed to succeed the late Prof. Silvanus P. Thompson, F.R.S., at Finsbury Technical College (p. 291).

THE Yorkshire Electric Power Co. show a net profit for the June half-year of £13,550, but no dividend is recommended on the ordinary shares.—The companies associated with Edmundson's Electricity Corporation show a drop in revenue of over £12,000 last year.—No dividend is declared on the ordinary shares of Messrs. Crompton & Co. for last year, although a balance of £10,479 is carried forward (p. 291).

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE.

ORDERS FOR AUGUST, 1916, BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Headquarters and Range.—The Headquarters will be closed during August, except on Tuesday evenings. The range will be open on Thursday evenings only. On these evenings the Sergeant-Major will take charge and be responsible for the maintenance of order and discipline. Recruits are urged to take advantage of this arrangement for drill and shooting.

Instruction Classes.—Instruction classes at Regency Street will be held as usual for Platoons Nos. 9 and 10.

Camp.—The Camp at Otford will be available until August 31st. Members wishing to attend should enter their names at Headquarters on the sheet provided for the purpose. The cost will be about 3s. per day. Members should provide themselves with 2 blankets, knife, fork, spoon, plate, mug, and a spare pair of boots.

Entrenching.—As many members as possible should endeavour to attend the Sunday Entrenching Parades, in order that the work to be done may be completed as expeditiously as possible. Parade in Uniform, as usual, at Victoria Station (S.E. & C. Rly.) Booking Office, 8.45 a.m. Members are reminded that this work is of national importance, and, therefore, all who are able to put in Saturdays and occasional week-days are urged to do so. They are reminded that they can obtain railway vouchers from the booking clerk by showing their cap badges.

Memorial to the Late Prof. S. P. Thompson.—Suggestions having been made in several quarters that a memorial to the late Professor Silvanus P. Thompson should be established, the Finsbury Technical College Old Students' Association have taken the matter up, and are now engaged on the formution of a scheme to enable all those interested to perpetuate the memory of the deceased in a suitable manner. Mr. J. E. Raworth, 28, Broadway, Westminster, S.W., is President of the Association.

Linking-up in London.—The communicating link between the Fulham and Battersea power-houses has been laid and is in operation. The Hammersmith Council has again entered into negotiations with the Battersea and Fulham Councils with the object, if possible, of agreeing to the conditions upon which the three authorities should carry out the linking-up scheme approved in 1915, but abandoned on account of Treasury restrictions as to capital expenditure. The proposal, of course, has been revived by the Board of Trade's recent letter on the subject of linking-up electricity works throughout the country, wherever this is possible. As we mentioned last week, a Committee of Western Metropolitan electricity undertakings has been formed with this object in view, of which Mr. A. J. Fuller, of Fulham, is secretary.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Discovery: or the Spirit and Service of Science. By R. A. Gregory. 340 pp. 7½ in. by 5 in. (London: Macmillan & Co., Ltd.) 5s. net; abroad, 5s. 8d.

At a time when the sins of others are keeping our thoughts trained on the applications of human knowledge to the destruction of human life, it is a welcome relief to turn to this graceful volume, in which Prof. Gregory preaches to us, with no small literary ability, the beautiful gospel of Science for its own sake. Roaming over many fields of endeavour, he tells of the work of the great minds who have striven throughout the ages to add to our understanding and appreciation of our stupendous universe. He shows us how the discoveries which have led to the greatest benefits to mankind have "been founded on researches undertaken originally with no industrial limitation and no lode-star of material reward." It was a happy thought to illustrate the book with reproductions of allegorical works of great artists. It is not every scientific work that includes in its list of illustrations such names as Lord Leighton, Auguste Rodin, and Giovanni du Bologna.

Large Electric Power Stations, their Design and Construction. By G. Klingenberg. English Translation. 260 pp. 10 in. by 7½ in. 173 figures and 7 plates. (London: Crosby Lockwood & Son.) 25s. net; abroad, 26s.

This, a translation of a work by a well-known German engineer, was, so we are informed by the publisher, actually in type before the war. Although, of course, based on practice which originated out of German conditions, the point of view is broad, and there is little in the general principles enunciated that is not capable of universal application. The economy of establishing a few large modern power-houses in a given area rather than extending small ones is kept in view throughout, and the principal points are discussed, which must be studied to keep capital expenditure at a minimum and working efficiency at a maximum. Chapters are included on generating costs (with figures in British and American currencies) and their relation to capacity and load factor is dealt with. In addition to the numerous reproductions of photographs and drawings of details of equipment illustrating the general principles as laid down in the earlier chapters, there are exhaustive descriptions of a large generating station near Berlin and the group of great power-houses on the Rand, which, to the shame of the British Empire, were allowed to be equipped with German plant. The illustrations form a special feature of the work, and its high price is largely accounted for by the presence of numerous large folding plans and sections of these and other stations.

A Manual of Practical Physics. By H. E. Hadley. 265 pp., 7 in. by 4¾ in. 153 figures. (London: Macmillan & Co., Ltd.) 3s.; abroad, 3s. 3d.

This is a very good little book, written on much the same lines as the author's well-known "Electricity and Magnetism for Beginners." It is obviously also written for beginners, dealing with the most elementary principles and leading up to the standard required for the pass intermediate examinations of various British Universities. Though it is intended as a laboratory text-book, we are inclined to think it will be more useful to those students who have not access to a good laboratory, as the guidance and instruction on practical work are much more detailed than is necessary or good for laboratory students. A useful list of exercises is appended at the end, many being taken from various examination papers.

Electrical Engineering: First Course. By E. J. Berg and W. L. Upson. 416 pp. 9¼in. by 6¼in. 296 figures. (New York: McGraw Hill Book Co. London: Hill Publishing Co., Ltd.) 17s. net.

This book differs from most elementary text books in being written, not as an exposition of the subject from which the student is to derive his initial knowledge, but as a supplement to a college lecture course. It is intended to be used "as a means of directing the student's effort toward comprehensions" of the ideas with which he is brought into contact in the lecture room and laboratory. Such a book has undoubtedly been desired by both lecturers and students. Most of the chapters of which there are forty-five, are brief and to the point, without lengthy explanations and illustrations, which are rightly left for the lecture room. A vast amount of ground is covered, and perhaps a little too much is attempted. The book would probably have been more useful if the treatment of elementary theory had been fuller, and the chapters on design curtailed somewhat. These chapters contain a great deal of approximate theory, sufficiently good no doubt for the elementary student, but to some extent unnecessary, for if the student follows up the subject of design he will cover the same ground in a more efficient manner in a more advanced course. However, the book is undoubtedly a good one for reference, particularly in respect of some subjects not usually treated in text-books, such as mechanical stresses in transformers, wave distortion in transformers, and the short-circuiting of alternators.

PROTECTION OF HIGH TENSION DISTRIBUTION SYSTEMS BY ISOLATING TRANSFORMERS

In a Paper read before the annual convention of the American Institute of Electrical Engineers, on June 28th, Mr. O. O. Rider called attention to the practicability of localising line disturbances by means of transformers. In the generation, transmission, and distribution of electricity, said Mr. Rider, there is growing the application of intermediate voltages for the supply of energy to the smaller communities and isolated industrial centres, forming a network of high-voltage distribution with characteristics in operation and maintenance that present new problems and require plans for protection differing from those on the low-voltage system used in urban distribution. This development applies more particularly in those sections of the country where the population is generally distributed, such as is found in the provinces. In choosing an electrical pressure for this work, 33,000 volts has been found to be the highest practicable voltage for pin type construction, and at the same time a voltage sufficiently low from which small amounts of power can be supplied economically to meet the growing commercial needs. It also appears that a system operating at this voltage is the most suitable intermediate step between very high voltages for delivery of large blocks of power over long distances, and the low-voltage system ordinarily used for distribution in the larger cities.

In the operation of such a system one requirement is at all times pre-eminent, namely, supplying continuous service over three wires. The non-grounded neutral system is used which permits service being maintained under conditions of accidental ground on one phase. This greatly lessens the chances of interruption by short-circuit, but, as is well known, it produces more surges for a longer time during an arcing ground than the grounded neutral system. Delta connection of transformers is used.

The chief aim of the Paper is to call attention to the improved operation obtained from isolating transformers on a non-grounded neutral system. The localisation of disturbances cause by single-phase accidental grounds is a matter of great concern, especially in high-voltage systems which extend over a large territory. A single defective insulator which earths a phase affects the entire system which is metallically interconnected. Small or local electric storms often develop in one section and cause this hazard to service in every other section. When the storm is general the entire system is subjected to these abnormal conditions from the time the storm enters the zone of electrical supply until it passes the remote sections supplied from branch lines. The troubles are multiplied accordingly.

In the growth of these large inter-urban systems small power plants are sometimes connected where the insulation of the line is not up to the highest standard, due to one cause or another. Also, where systems are connected together for interchange of power, the possibility of trouble from accidental arcing ground is multiplied by this extension of territory covered by the two systems. In many such cases it is undesirable to use automatic circuit-breakers at the connecting points to disconnect the power when the trouble is due only to unbalanced electrostatic conditions of the phases.

In these cases isolating transformers between the systems can be advantageously used. These transformers may be either 1 to 1 ratio or they may step down the power to a lower distributing voltage and up again to the transmission voltage, according to the attending conditions. It is desirable, of course, to locate these stations where local distributing service is required. Where a section is to be isolated by this means, an added advantage comes in the use of standard regulators for the maintenance of voltage. This plan of regulation will be found to care for voltage conditions at intermediate points and eliminates the necessity of supplying a great number of regulators for the small communities.

With these isolating transformers the disturbance of an accidental arcing ground on one section is confined entirely to that section, and still power is transmitted without interference to and from all other sections as under normal conditions. On each section where an accidental arcing ground takes place the proper protective devices should be used to protect from abnormal voltages. The arcing ground suppressor has been recommended and used. It was not the author's object to treat these details, but simply to record the successful use of the isolating transformer, which limits the disturbances to one part of a large system.

GERMANY'S PREPARATIONS FOR PEACE

An interesting article in the July issue of the *B.E.A.M.A. Journal* by Mr. F. W. Wile, late *Daily Mail* representative in Berlin, gives a concise compilation of Germany's deliberate "preparations for peace." Germany's foreign trade at the outbreak of war in 1914 represented a volume of roundly £1,040,000,000 (we analysed Germany's electrical export trade in Electrical Engineering, August 13th, 1914, page 454). A little less than half of the grand aggregate was export trade—say, £500,000,000, of which £380,000,000 represented trade in Europe, and £120,000,000 trade outside Europe, or so-called "oversea" export. According to statistics published in the *Frankfurter Zeitung* of May 14th, the British Empire in the fiscal year 1913-14 bought £167,500,000 worth of German goods, this accounting for about exactly one-third of Germany's total export trade. This creation of years of scientific and intensive effort and exploitation collapsed like a house of cards when the British mastery of the sea wiped Germany out of the world's markets as completely as if the Hamburg-American line and the North German Lloyd had never existed, and the Germans have set to work to restore the demolished structure at as early a date as possible.

Mr. Wile considers no development of Germany's peace preparations more significant than the announcement made in Berlin on June 2nd that the six leading engineering societies of the German Empire have amalgamated "for the purpose of confronting the great new tasks which now so urgently require to be co-operatively solved."

The Deutscher Verband technisch-wirtschaftlicher Vereine (German League of Engineering-Economic Associations) has been formed out of the following: Verein Deutscher Ingenieure (Society of German Engineers), founded 1856, forty-eight branch societies, 24,500 members; Verband Deutsche Architekten und Ingenieur-vereine (League of German Architects and Engineers), founded 1871, forty-nine branch societies; Verein Deutscher Eisenhutteleute (Society of German Iron-Furnace Men), founded 1880, 6,000 members; Verein Deutscher Chemiker (Society of German Chemists), founded 1887, thirty-six branch societies, 5,500 members; Verein Deutscher Elektrotechniker (Society of German Electrical Engineers), founded 1893, twenty-two branch societies, 6,000 members; Schiffsbautechnische Gesellschaft (Society of Marine Engineers), founded 1809, 2,000 members.

The avowed object is to serve German industry "co-operatively" in the supreme test which awaits it—*i.e.*, the re-conquest of whatever portion of its pre-war position may still be attainable. The preamble of the new League sets forth that it will devote itself quite particularly to promoting technical education, especially in the direction of *standardising* it. It also aims to make itself the principal adjunct of State and muncipal authorities in framing laws appertaining to engineering and the engineering trades. The President is Privy Councillor Professor Busley, of Berlin, Germany's most eminent marine engineer, and the League has established national headquarters in Berlin, its activities having already begun.

After recounting various significant expressions in the Reichstag regarding Germany's future trade plans and aspirations, Mr. Wile points out that in the electrical trades expansion seems also to be the order of the day, even though "centralisation" had reached a high state of development before the war, and resulted in the acquisition of almost monopolistic power by the A.E.G. and Siemens-Schuckert group. Early in June last the "Electrical Company, Ltd., formerly W. Lahmeyer & Co.," of Frankfort-on-the-Main, announced that it had called up the 75 per cent. balance of £250,000 new shares issued in December, 1913. The money was required for the completion of new plant and extensions, which had remained in abeyance, and the cost of which will "run into millions."

Many instances are given of the efforts which are now being carried out in Germany towards industrial centralisation and organisation, and particularly important is the position as regards shipping, in connection with which the representative of the Ministry of the Interior in May this year made the announcement that the Treasury intends placing "not inconsiderable means" at the disposal of German shipping lines for the rehabilitation of the mercantile marine.

The Germans believe that the foreign trading universe will prove to have too short a memory for the horrors which have besmirched the German name during the war to be governed by any other factor than the sordid law of price, supply, and demand. They believe that the German, order-book in hand, will be as welcome in Britain as he was before, if he comes again with the proper samples, the attractive quotations, and the old-time oiliness of manner and suasion. Forewarned is forearmed, and if present indications count for anything, "German business will essay its Horn's Reef the moment the military and naval war is ended. It will be beaten back to port in Hamburg and Bremen, effectually lamed, only if sagacious knowledge of its plans and resources enables British business to meet the onslaught betimes and repel it."

ROAD CHARACTERISTICS STUDIED BY MEANS OF THE ELECTRIC VEHICLE

The results of a recent investigation into the properties of various types of road have been outlined by Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, and are published in the *Electrical World*.

The tests were conducted mainly in 1915 under the immediate direction of Dr. A. E. Kennelly and Otto R. Schurig of the research division of the electrical engineering department, and emphasise the importance of smooth roads in motor-vehicle operation. It is expected that the details of the investigation will be published by the Institute in a special bulletin within the next three months. The tests were made with a 1,000-lb. electric delivery waggon equipped with solid tyres, roller bearings, and provided with a worm drive and differential gearing. Before the road tests were made the vehicle was operated in the laboratory to determine its efficiency from battery terminals to wheel-rims. This ranged from a maximum of 55 per cent. on the first position of the controller handle to a maximum of 78 per cent. on the fourth or final position. In most of the runs the efficiency varied between 60 per cent. and 75 per cent.

Comparative data for level roads of different construction and condition were expressed in the pounds per short ton required to propel the vehicle on a level road at various speeds, including the air resistance with no wind blowing, but not including the internal losses in the truck. On tar macadam in good condition and wet, the tractive resistance east-bound varied from 27 lb. per ton at 12 m.p.h. to 30 lb. at 15·5 m.p.h.; west-bound the tractive effort varied between 20 lb. per ton at 10 m.p.h. and 24 lb. at 14 m.p.h. On an asphalt road in fair condition the tractive effort ranged from 20 lb. per ton at 10 m.p.h. to 24 lb. at 15·5 m.p.h. With the asphalt in poor condition the tractive effort was increased about 10 per cent. Eliminating the air resistance, a constant tractive effort of 17 lb. per ton was required between 10 m.p.h. and 15 m.p.h. on asphalt pavement.

On wood-block paving in good condition the tractive effort ranged from 22 lb. per ton at 10 m.p.h. to 24 lb. at 14·5 m.p.h. In general, eliminating wind effect, the resistance of wood-block paving was about 15 per cent. greater than that of asphalt. Brick paving in good condition showed a slight increase in resistance over the wood blocks, and with the bricks slightly worn the resistance ran up somewhat higher. Tar macadam in good condition showed about the same resistance as an ordinary water-bound macadam with a fine surface in good shape. A 50 per cent. increase resulted from a macadam road in poor condition through holes. The resistance of heavily-oiled macadam roads was rather high, and between 7 and 13 m.p.h. on a freshly-tarred, soft road the resistance varied between 32·5 and 35 lb. per ton.

Gravel and cinder roads showed about 10 or 15 per cent. more resistance than good macadam. Granite-block paving proved to be the worst road for mechanical traction, a road of this type on a concrete base, but with sand and gravel interstices, showing two and a half times the resistance of asphalt or wood blocks, the resistance of a granite block road with cement joints being about 60 per cent. greater than that of asphalt. With a granite road the resistance increases with speed when the still air resistance is eliminated, due to impact resistance. Asphalt, as stated, gives a straight-line curve of tractive effort and speed between 10 and 15 m.p.h.

From these facts the inference is drawn that eventually smoother roads must be employed in American cities as in London, Paris, Berlin, and other European centres. Such roadways will mean an increased radius of service for the electric vehicle, owing to the enlarged mileage secured per battery charge resulting from decreased traction requirements.

Professor Jackson said that the investigation should be continued for at least another year in order to enable the effect of different chassis, spring systems, &c., to be studied. Because of its power-measuring capabilities, the electric vehicle is an unusually valuable device in the study of road conditions.

Obituary.—A notable figure in the world of science has passed away in the death of Sir William Ramsay, K.C.B., F.R.S., on Sunday. His work, which was chiefly in the domain of chemistry, was known all over the world, and in 1904 he was awarded the Nobel Prize.

I.E.E. Wiring Rules.—We are asked to notify the following corrections in the Seventh Edition of the Institution wiring rules:—

Rule 117 (*b*), line 1, for "Fitted with" read "Controlled by."
Rule 121 (*b*) applies to lighting circuits only.
Page 42, line 30, for "Decks" read "desks."

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,504.

Three 50 h.p. shunt motors are driving separate lines of shafting, and it is proposed to couple these lines into one shaft and to fit an additional (stock) 40 h.p. shunt motor to cope with an increased load. As belt-drives are employed, will the motors take their proper share of the varying loads without constant adjustments to their field regulators, or could this be ensured by any means of compounding the motors?

(2) Are the conditions altered in either case by fitting interpoles?

(3) Would the motors divide their loads in the correct proportion if a positive drive were employed, *i.e.*, gear or chain instead of belts, whether or not shunt or compound windings were employed?—PUZZLED.

(*Replies must be received by first post Thursday, Aug. 3rd.*)

ANSWERS TO No. 1,502.

I am in charge of a test room in which we have a small D.C. separately excited generator, with interpoles giving 2 amps. at 600 volts. A much larger one has now been installed, and I wish to use the small one as a motor, but find on connecting up that it only revolves very slowly and also sparks badly. I have tried changing over the interpole-connection, but with no better result. What is the trouble?—INTERPOLE.

The first award (10s.) is made to "Koil" for the following reply:—

It would have thrown more light upon the matter if the amperes taken as motor and the speeds as dynamo and as motor had been given, but, failing this information, the following remarks will indicate the probable cause of the trouble.

In a machine of this output the voltage drop in the commutation pole and armature windings would be of the order of 100 at full-load current. Assuming this figure, then, as a dynamo, the internal volts generated would be 600 + 100 = 700 v. Now, as a motor, the speed will only be the same as the dynamo speed when the back E.M.F. is 700, the current and excitation being unchanged. But actually the applied voltage is only 600, and the back E.M.F. is only 600 — 100 = 500; consequently the speed will only be $\frac{500}{700}$ = 71·4 per cent. of the dynamo speed. Further, the speed will increase or decrease according to whether the armature current is less or more than 2 amperes.

The information given indicates an armature current in excess of 2 amperes, and this may be due to incorrect brush position. If the brushes are far back from the neutral axis, the extra current taken will so increase the voltage drop in the motor windings that this will more than counterbalance the extra demagnetisation, due to the armature ampere turns, and the speed will be reduced.

The interpole magnetic system may have become so saturated as to prevent proportional increase of interpole flux, thus accentuating the sparking, due to incorrect brush position.

If the brushes are correctly placed, the trouble may be due to some cause, such as entirely or partially short-circuited armature coils or excessive friction, the sparking again being due to a more or less saturated interpole system. The latter of these troubles may have been existent when the machine was running as a dynamo, as the extra power demanded would, in that case, have been supplied mechanically and would not interfere with the electrical characteristics. Finally, it must be borne in mind that all losses are now supplied by the power mains, which in itself probably accounts for quite an appreciable current, even at light loads.

The second award (5s.) is given to "Y. Z." for the following:—

One or two rather important data are omitted from the statement in the question, but it is possible to suggest a few likely causes for the results described. In the first place, it is not correct to change over the interpole connections, if the armature and interpoles have previously been relatively correctly connected. The polarity of the interpoles must always have a definite relation to the polarity of the armature, as is well known, and this can be secured only by first of all getting correct connections, and then leaving these unchanged, whatever happens as regards the function of the machine, as any change in the direction of current, on changing from generator to motor, will change the polarity of both armature and interpoles, and will therefore keep them relatively correct. To change the interpole connections over is to make the interpoles have the wrong polarity relatively to the armature, and this can only increase the tendency to spark. The sparking experienced on trying to run the machine as a motor was thus not due to any wrong connections inside the machine. One of two causes might produce it—or both, acting together, namely, overload or wrong brush position. A small 600-volt machine, unless very well compensated by its interpoles, will soon have sufficient unbalanced reactance voltage, as load rises above its normal value, to make it spark. An ammeter in circuit will show how matters stand in this respect. A high-voltage machine also has rather a narrow range of commutation as a rule, and unless the brushes are exactly neutral—say, they have been slightly in front of neutral for working as a dynamo—they would not be in the correct position for working as a motor in the same direction of rotation as before, but would be too far forward. Probably, therefore, the sparking would diminish if the direction of rotation were reversed, or if the brushes were put back and the old direction of rotation kept. Both the possible causes of sparking are, therefore, suitable subjects for experiment.

In regard to the slow speed, one cause is clearly that the generated electromotive force of the machine is less than before (it is assumed that it is to work as a motor on a 600-volt circuit, the same as when it worked as a dynamo), since previously it would generate 600 volts *plus* the volts lost in the armature and interpole copper, and now it has to generate only 600 volts *minus* the lost volts. In a small machine like this, the loss may be as much as 10 or 15 or even 20 per cent., according to the speed (this is not stated), so that, as the generated electromotive force changes by twice the lost volts, the speed would drop, other things being equal, to 0·90/1·10 or 0·85/1·15 or even 0·80/1·20, *i.e.*, to 0·82 or 0·74 or even 0·67 of its former value from this cause alone. The question does not state the voltage of the separate exciting circuit, but it is assumed that the field is kept working from the same source as before. If, however, there were a shunt regulator before, and this has by any chance been cut out, the field will be stronger than before, which will further decrease the speed. And if, again, the brushes are in the wrong position, as has been suggested above in connection with sparking, they will, if too far forward, allow the interpole flux to act as a compounding flux in the cumulative direction, and add to the effect on the speed, in addition to the fact that the armature will also be strengthening the field with the brushes in this position, by the well-known effect of its reaction.

Investigation along the lines of these suggestions will most likely lead to the discovery of the source of the trouble.

Diesel Engine Crankshafts.—In a Paper read before the Diesel Engine Users' Association on July 12th, Mr. Philip H. Smith discussed the question of prolonging the life of crankshafts. He demonstrated that shaft failures are usually due to lack of alignment of the main bearings, frequently the result of unequal rates of wear of the several bearings. He advocated keeping an exact record, taken by micrometer, of the wear of bearings, and scraping those which have worn least to bring them into alignment with the others. He proposed the following empirical formulæ for shaft dimensions, where D is the diameter of cylinder bore:—

Tensile strength, not less than 34 tons; ductility not less than 25 per cent. in 2 ins.; diameter of pins and journals, 0·525 to 0·54 D; length of main bearings, 0·75 to 0·8 D; length of big end pin, 0·525 to 0·54 D; thickness of webs not less than 0·32 D, but centre to centre of cylinder made minimum possible, and any excess over the proposed length of pin and journal to be put into the webs. Fillets to be not less than 1/10 the diameter of the shaft.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published July 20th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

29,825/13. **Petrol Electric Traction.** H. PIEPER. A "mixed" system of vehicle drive in which a dynamo capable of acting also as a motor, connected across a battery and coupled by a magnetic clutch to the main driving shaft, co-operates with the engine with which it can be coupled or uncoupled either by hand or automatically. The automatic action is controlled by the current from and voltage of the battery and also by the gradient upon which the vehicle is travelling. (Three figures.)

9,557/15. **A.C. Motors.** B.T.-H. Co. (*G.E. Co., U.S.A.*) A method of casting squirrel cages for induction motors in the slots of the core by surrounding it with a suitable mould and rotating it while the molten metal is being poured in so as to drive the metal by centrifugal force into the slots and ring recesses. (Four figures.)

10,330/15. **Reactance Coils.** G. HARLOW. A reactance coil with two windings having a common magnetic circuit. One winding is included in a feeder circuit and the other short-circuited. Provision is made for relative movement of the windings so that when a heavy current flows in the feeder the windings separate owing to their mutual repulsion and increase the choking effect of the coil. (Two figures.)

12,994/15. **Tungsten Arc Lamps.** G. M. J. MACKAY. A tungsten arc lamp with electrodes in a tult filled with an inert gas and containing mercury or other vaporisable substance. An incandescent tungsten filament is also provided which just acts as a heater to vaporise the mercury to enable the arc to strike and subsequently as a steadying resistance. (Two figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: SCHOLES [Joint] 9,964/15.

Heating and Cooking: DOWSING and HUNTLEY [Heating elements] 9,828/15; CRARY [Stoves] 14,783/15.

Ignition: NIELSON [Ignition devices] 13,964/15.

Incandescent Lamps: JULIUS PINTSCH A.G. [Filament supports] 17,022 and 17,023/14; HUNTER [Lamp caps] 13,943/15.

Switchgear, Fuses, and Fittings: GENERAL ACCESSORIES Co. (*Rosenthall and Seymour*) [Lampholders] 15,459/15.

Telephony and Telegraphy: ALDENDORFF [Automatic telephone exchange working] 2,530/14; DE FOREST [Wireless telegraphs and telephones] 6,486/15; UNITED TELEGRAPH & CABLE Co. and BRUCE [Relays] 9,496/15; RELAY AUTOMATIC TELEPHONE Co. and BYGRAVE [Impulse transmitters] 9,852/15; DAHL [Telegraph transmitters] 11,776/15; MARCONI'S WIRELESS TELE. Co. and TROST [Wireless transmitters] 11,831/15; BULLERS, LTD., and DAGNALL [Insulator curves] 12,276/15.

Miscellaneous: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Apparatus for coiling wire] 9,476/15 and [Electric discharge apparatus] 9,690/15; BELLAMY [Miners' lamps] 13,807/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Arc Lamps: E. A. SPERRY [Searchlights] 6,129/16 (*100,781*).

Heating and Cooking: LANDIS & GYR A.G. [Heating device] 18,070/15; BRITISH WESTINGHOUSE ELECT. & MFG. Co. [Liquid heaters] 9,111/16 (*100,796*).

Ignition: C. MESSERSCHMIDT [Magnetos] 6,379/16 (*100,782*).

Switchgear, &c.: A. G. BROWN, BOVERI & CIE [Voltage regulators] 8,698/16 (*100,788*).

Miscellaneous: F. G. SIMPSON [Spark gap] 9,105/16 (*100,795*).

Opposition to Grant of Patents

The grant of a Patent on the following specification has been allowed in spite of opposition:—

11,555/15. **Wireless Telegraphy.** F. K. VREELAND. A system of wireless telegraphy in which undamped oscillations are generated in a circuit containing a mercury vapour arc with a restricted area of high energy transforming capacity.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

16,923/02. **Lamp Manufacture.** H. H. LAKE (*G.E. Co., U.S.A.*). A machine for moulding filament supporting pillars or stems.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: R. D. ARCHIBALD [Three-phase power transmission] 7,933/07.

Electrometallurgy and Electrochemistry: GALVANOSTEGIE SHARNKE and DOBRITZ [Electroplating tubes, &c.] 7,508/08.

Instruments and Meters: W. W. LACKIE [Maximum demand indicator] 8,392/06.

Storage Batteries: ACCUMULATORENFABRIK A.G. [Wooden separators] 8,352/06.

Switchgear, Fuses, and Fittings: SIEMENS BROTHERS' DYNAMO WORKS, LTD. [Cartridge fuses] 8,263/09 and 25,733/09.

Electric Conductors.—The July issue of the *General Electric Review* contains the second instalment of an article by C. P. Steinmetz, in which he discusses the classification of various types of electric conductors. The various classes of conduction are given as follows: metallic conduction, electrolytic conduction, pyroelectric conduction, insulation, gas, vapour, and electronic conduction; these are only characteristic types, but numerous intermediaries exist, and transition from one type to another by change of electrical conditions, of temperature, etc., is possible. As regards the magnitude of the specific resistance or resistivity, the different types of conductors are characterised as follows: The resistivity of metallic conductors is measured in michrom centimetres. The resistivity of electrolytic conductors is measured in ohm centimetres. The resistivity of insulators is measured in megohm centimetres and thousands of megohm centimetres. The resistivity of typical pyroelectric conductors is of the magnitude of that of electrolytes, ohm centimetres, but extends from this down towards the resistivities of metallic conductors, and up towards that of insulators. The resistivity of gas and vapour conduction is of the magnitude of electrolytic conduction; arc conduction of the magnitude of lower resistance electrolytes, Geissler tube conduction, and corona conduction of the magnitude of higher resistance electrolytes. Electronic conduction at atmospheric temperature is of the magnitude of that of insulators; with incandescent terminals it reaches the magnitude of electrolytic conduction.

Niagara Falls Power Supply Shortage.—*The Times* Toronto correspondent states that a disconcerting situation has developed at Niagara Falls. The Provincial Hydro-electric Commission, which supplies power to Toronto, Hamilton, London, and many other municipalities throughout the province is unable under its contract with the Canadian Power Company to secure sufficient energy to maintain the service. As a result the Ontario Government has asked the Dominion Government to prohibit the export of power to the United States. If the request be granted many American industries will be seriously affected by the stoppage of the supply of energy from Niagara.

Enemy Firms Wound Up.—Among the latest list of enemy firms which the Board of Trade have required to be wound up under the Trading with the Enemy Act is that of Messrs. Balcke & Co., water cooling tower engineers, Broadway Court, Broadway, Westminster, S.W. The controller is Mr. J. W. Barratt, 19A Coleman Street, E.C.

ELECTRIC TRACTION NOTES

In a paper read at the Annual Conference of the Institution of Municipal and County Engineers recently, Mr. James Bee, Cleansing Superintendent to the Blackpool Corporation, gave particulars and working costs of a 3½-ton electric vehicle which is used almost exclusively for street-watering purposes. The total weight when empty is 5 tons, but when full this is increased to 8 tons 10 cwt., the capacity of the water tank being 750 gallons. The chassis is 18 ft. 6 in. long and 6 ft. 9 in. wide, and the vehicle is equipped with an Ironclad "Exide" battery, consisting of 44 cells, which are charged from the refuse destructor electric plant at a charge of 1d. per unit. The recharging of the batteries takes about six hours, and is carried out during the night, a boosting charge being given during the dinner hour. During an average day of nine hours, the vehicle waters about 40 miles of streets, using 22 loads, or 16,500 gallons of water. The consumption is about 7½ ampere-hours per mile. On the level the vehicle can travel at 10 miles an hour, and one charge enables about 40 miles to be covered. During the eight months it has been at work 4,261 units have been used, and the total cost, including driver's wages, insurance, depreciation of tank, batteries, and tyres, has amounted to £135. This has proved a great saving over the cost of the six horse-drawn watering vans previously used. The total mileage covered has been 2,566, and the miles of street watered 1,713.

At the Lincoln County Court last week a farmer was awarded £50 damages against the Lincoln Corporation in respect of injuries to a horse, which had eventually to be destroyed, through the animal stepping on to a "live" stud of the surface contact tramway system. For the Corporation it was urged in defence that there had been no negligence, as one of the Corporation employees immediately after the accident had been able to place his hand on the stud without inconvenience.

Interim dividends have been announced by the District Railway Co. and its associated tube lines. The full 4 per cent. is paid on the 4 per cent. Guaranteed stock, 4½ per cent. on the First Preference stock, and 3 per cent. on the Second Preference stock of the Metropolitan District Co., 1½ per cent. on the Ordinary stock of the City and South London Co., and 3¼ per cent. on the undivided Ordinary stock of the Central London Co.

It is stated that three experts have reported to the Edinburgh Corporation in favour of converting the cable lines to electric traction, details being given of the manner in which the cars could be ready for running at midnight on June 30th, 1919, when the tramway lease ends. The report, of course, is only interim, and the matter is to be discussed at the next meeting of the Tramways Committee.

The Bristol Corporation Tramways Option Committee, which was appointed in February, 1913, to consider the question of purchasing the Bristol Tramway Co.'s undertaking, has reported that expenses amounting to £8,068 have been incurred.

Considerable progress has been made during the past two years by the Electric Vehicle Committee of the I.M.E.A. in the matter of organising facilities for road transport by means of electric-battery vehicles. The constitution of the committee is on a broad basis. It includes representatives of the parent association, the Commercial Motor Users' Association, the Royal Automobile Club, the Society of Motor Manufacturers and Traders, the Provincial Electric Supply Companies, the Electrical Contractors' Association, the British Electrical and Allied Manufacturers' Association, the Incorporated Association of Electric Power Companies, the Institution of Municipal and County Engineers, and of the Tramways and Light Railways Association. The Chairman of the Committee is Mr. R. A. Chattock, City Electrical Engineer at Birmingham. The Hon. Secretary is Mr. F. Ayton, Chief Engineer and Manager of the Ipswich Corporation Electric Supply and Tramways Depts. The electric vehicle has its own special field in goods delivery work in urban and suburban areas, and the excellent results that have, so far, resulted from its use by some of the largest and most up-to-date business firms would seem to indicate quite a considerable field for its extended employment in the future, not only for the delivery of merchandise, but also for passenger-carrying work in and about towns and cities. The economy in operating cost and the simplicity of the mechanism are, of course, the main features of this class of vehicle. While these advantages were manifest in the period before the war, the present scarcity of horses, the high price of fodder, and the restrictions on the use of petrol, to say nothing of the rising cost, very greatly enhance the merit of economy possessed by "the electric."

DIESEL ENGINES FOR STEAM PLANT EXTENSIONS

In a paper entitled "Oil engines and steam engines in combination," read before the Diesel Engine Users' Association recently, Mr. G. Porter discussed some of the problems met with in extending a comparatively inefficient generating station of the "lighting load" order, with a plant capacity round about 1,500 kw., and equipped with steam engines, some with condensers and some without. Mr. Porter dealt in particular with three generating stations—one on the South Coast, one in London, and one in the provinces—in which Diesel engines have been introduced to increase the station capacities. He said that the Diesel engine is now making good headway, and though the capital cost is high, the balance in hand to credit of net revenue account in the annual balance-sheet is found to improve in proportion to the use of the Diesel engine. The mixed stations have justified the wisdom of their engineers during the present difficult times; but for their efficient oil engines many of them would be in a bankrupt condition to-day.

From figures given for the three stations dealt with it was shown that the lower operating cost of a Diesel plant quickly extinguishes the higher annual charges for capital even though in one case the steam plant has an advantage of £0·33 per kw. in respect of capital charges. A table was given of comparative generating costs in the three stations before and after the installation of Diesel engines. These show a reduction in the cost per unit generated of 0·36d., 0·05d., and 0·28d., respectively, these figures being obtained in the face of rising fuel prices. Similarly, the overall thermal efficiencies had improved, in one case from 5 to 22 per cent.

Continuing, the author said that the Diesel engine has this important advantage over the steam equipment, if valves are leaking and adjustments are not in order the fact becomes quickly obvious. The indications on the gauges (and there are not many of them) draw one's attention to irregularities. But a steam engine may run beautifully to the outward eye and ear although piston valves and piston rings may leak, and the valve settings may be wrong owing to eccentric strap wear; the boiler settings may be drawing many cubic feet of air into the flues; the fires may be too thick or too thin. In very many cases, provided the main steam gauge is showing about the correct steam pressure, there is a general feeling of satisfaction with the aspect of affairs. The author himself had improved steam costs by 20 per cent. or so in one station by the aid of flue thermometers, draught gauges, flue gas analysers, and graduated staffs in the boiler-feed water tanks; but even at that the benefit was but a fraction of that gained by purchasing plant that was inherently more efficient from the thermal point of view. Putting the three things together, capital charges, running costs, and gross profits, the advantage accruing from the use of the Diesel engine for installations within the limits of those indicated in the paper was manifest.

CATALOGUES, PAMPHLETS, &c., RECEIVED

BLUE PRINTING APPARATUS.—A new and improved method of blue printing is described in a pamphlet issued by the Westinghouse Cooper Hewitt Co., Ltd. (80 York Road, King's Cross). In the continuous type of blue printing machine illustrated a continuous roll of printing paper is fed on to a cylinder of glass inside which are one or more Cooper Hewitt tubes. The cylinder rotates, being driven by motor, and any length of print, or any number of small prints, can be fed on to it. A stationary type of machine is also manufactured. There is further described a combined washing, drying, and ironing machine, the principal features of which are a tank for washing prints, a wringer, a hot drum for drying and ironing, and an automatic winding-up device for long prints as they come from the drier. This machine will deal with prints up to 60 inches wide.

Readers desiring copies of catalogues or pamphlets should apply to the firms in question, referring to the notice in "Electrical Engineering."

TECHNICAL BOOKS.—Messrs. Constable & Co. (10 Orange Street, Leicester Square) have sent us a copy of their list of recent publications, which includes a number of books on electrical and allied subjects.

GERMAN ADMINISTRATION OF BELGIAN TELEGRAPHS AND TELEPHONES

SOME interesting information on the position of telegraphs and telephones in Belgium as at the middle of February, 1916, is given in *The Telegraph and Telephone Journal* from a semi-official German production. The Belgian Telegraph Administration, before departing, had naturally taken good care to leave the telegraph and telephone system in as useless a condition as possible, and the Germans had no easy task in restoring a limited system of communication for military and hospital needs. Plans and records were either removed or altered so as to give rise to short circuits or false connections. Many of the cables and wires were damaged either purposely or owing to the exigencies of war, and long sections of the routes were in indescribable confusion. The apparatus was in many cases destroyed altogther or rendered unusable by the removal of parts. The apparatus room of the chief telegraph office in Brussels was so devastated that it was necessary for some time to employ a temporary office with new apparatus. In Antwerp, when the Germans took possession of the head office two days after the fall of the fortress, we learn that they were able to rectify the false connections at once, and traffic was thenceforth resumed without disturbance. In a comparatively short time the larger offices at Brussels, Antwerp, Liège, Ghent, Charleroi, and Verviers were in full working order. The telegraph traffic between Brussels and Germany was said to be very heavy, and the Siemens rapid telegraph system was brought into use in order to deal with it. Private installations necessary for police, fire, water, tramways, gas, electrical, and similar purposes were restored, some fifty private systems being permitted by the general government. Telegraph and telephone lines have been restored up to a length of about 8,000 kilometres of wire, and about 5,700 km. of aerial routes, mostly along the principal railway lines. The telegraph system is divided into 27 districts; 58 telegraph offices are available for public traffic, and 521 exclusively worked by the military provide for military and Governmental needs. Two sets of Siemens rapid telegraph apparatus as well as numerous Hughes type-printers, sounders, and Morse instruments are in use.

Private telegrams of a pressing nature with an unlimited number of words are allowed in German, Flemish, or French at a charge of 1 fr. for every ten words, excluding the address. Telegraph traffic is permitted between certain places in Belgium and Germany in German or French, but from Germany to Belgium only in German. Information about troops, military or naval movements is forbidden. For this service the charge on an ordinary telegram is 50 c. plus 9 c. for every word; for urgent telegrams 150 c. plus a charge of 27 c. for each word. The private telegraph traffic has developed favourably, amounting within Belgium to a monthly total of over 20,000 telegrams. The Belgian people are not so fortunate with regard to telephones; it is said that private telephone traffic is not "yet" permitted. The number of telephones, which was probably 50,000 before the war, is now 4,700, of which 1,800 are in Brussels. We may assume that this poor number only serves the host of German officials, military and civil, with which the unhappy country is infested. The telegraph and telephone staff is, of course, entirely German, and consists of about 280 officials, 80 officers of lower rank, and 320 telegraphists, besides a number of military.

Tar Oils as Fuel for Diesel Engines.—During a discussion at the Diesel Engine Users' Association, Mr. Napier Prentice (Suffolk Electricity Supply Co.) gave his experience of the use of tar oil which he had obtained from a local distiller. He had found difficulty in obtaining quotations and in getting the work in hand of altering a Diesel engine so as to specially adapt it for the use of tar oil in the manner which had been successfully employed on the Continent, and he decided to try the effect of using tar oil in one engine without any alteration. At about half-load he found this was not successful, as mis-firing and a smoky exhaust occurred. He was advised to work with a sharp edge on the flame plate, and with this alteration and a slightly different quality of tar oil he obtained satisfactory results so long as the engine was not run below about three-quarters of full load. The blast pressure at all running loads was maintained at five atmospheres below the normal pressure used when running with petroleum fuel oil, and the cooling water outlet was restricted so as to maintain a temperature of 125° F., as against 110° F. which had been maintained when using the other class of fuel oil.

THE CONTROL OF SMALL C.C. MOTORS

WITH certain small motor-driven apparatus and appliances it is essential that the control switch should be as small as possible, and low cost is also a consideration. These conditions are fulfilled by the recent modification of the "Twinob" switch, illustrated in Fig. 1, with its cover removed. The only difference between this and the standard construction is that

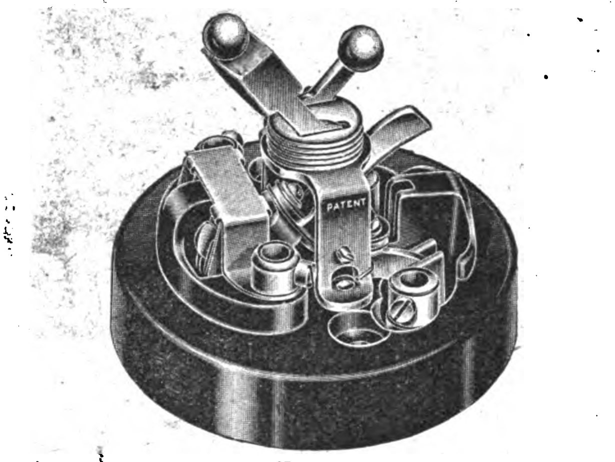

FIG. 1.

one of the levers has an open box at its extremity. This box encloses the knob of the other lever when both are on or both off, and it prevents the other lever being put on or left on by itself. When starting the motor the box lever is put on first and serves to start a small shunt or series motor through a resistance, the latter being bridged when the other lever is put on.

The control in Fig. 2 puts the two field sections of a shunt motor in series for full speed, or parallel for low speed. The switch consists of a two-way-off and a series-parallel-off switch

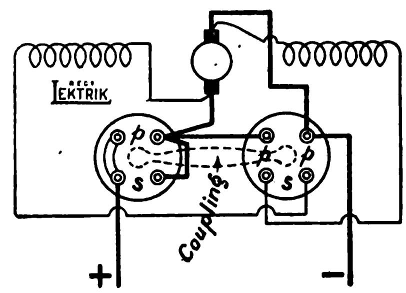

FIG. 2.

coupled together. The diagram shows the circuit conditions when the switch is off. In the series position the gaps marked *s s* are bridged; and in the parallel position those marked *p, p, p*. Another coupled switch will start, stop, and reverse a small series motor.

The makers are Messrs. A. P. Lundberg & Sons, of 477-489 Liverpool Road, London, N.

Certified Works.—The increasing extent to which electricity works and tramway undertakings are being "certified" by the Ministry of Munitions had a sequel at the Oldham Munitions Court last week, when a smith in the employ of the Stalybridge, Hyde, Mossley & Dukinfield Tramways and Electricity Board asked permission to leave. Mr. R. Blackmore, the Engineer to the Board, relying upon the fact that the Ministry of Munitions had "certified" the works, objected to the leaving certificate being granted, and alleged that the man wished to leave merely in order to earn more money elsewhere. The man, however, said he made his application on the ground of his wife's health. The leaving certificate was refused, with permission to apply to the Court if the wife's health became worse.

Hull Municipal Telephones.—The result of the first year's working of the Hull Corporation telephone system since the old National undertaking was taken over from the Government, show a net profit of £3,645 after making allowances for war bonus to the staff and other special charges.

London Wiremen's Wages.—It is announced that electrical wiremen in the London district have been granted an advance of ½d. per hour by the Committee on Production.

An increase of ½d. per hour has also been granted to Edinburgh wiremen, with the promise of another ½d. in September, providing the general cost of living has not gone down meantime.

STARTERS FOR INDUCTION MOTORS

A VERY neat form of hand-operated starting compensator for two- and three-phase squirrel-cage induction motors is being placed on the market by the British Thomson-Houston Co., Ltd. (Rugby). It consists essentially of an auto-transformer for reducing the stator voltage on starting. There are three positions for the operating switch handle, an "off," a "starting," and a "running" position. The apparatus is manufactured in two types, one for floor mounting, and one, of which we give an illustration, for wall suspension. The operating handle is fitted with an automatic latch, which ensures the former being thrown from the "off" to the "starting" position, and prevents it being thrown directly from the "off" to the "running" position. A strong spring also prevents it being left in the "starting" position. The switch can be changed from the "starting" to the "running" position only by means of a rapid movement of the handle, thus preventing any decrease in the speed of the motor, and consequent increase in current, when effecting this change. A low-voltage release, which is supplied with all sizes of compensators, ensures the switch returning to the "off" position when the voltage fails or drops considerably. Overload protection, if required, can be obtained by the provision of overload relays.

LOCAL NOTES

Burton-on-Trent: *Street Lighting.*—The Borough Council Engineer has prepared a scheme for lighting the main thoroughfares by lamps suspended at different parts of the tram routes. The object is to arrange for the street lights to be extinguished at the same time as the tramway current is turned off at the power-house when warning is given to take anti-aircraft action.

Carlisle: *Position of Electricity Undertaking.*—In dealing with the past year's working of the electricity undertaking at the last meeting of the Corporation, the Chairman of the Electricity Committee pointed, with a certain amount of pride, to the fact that, although the majority of towns in the country have been compelled to raise their charges, the Carlisle Committee has so far been able to avoid taking this step. In Carlisle, as elsewhere, it is the power load which has saved the situation, a revenue of £16,000 being derived from 154 consumers, whilst nearly five times that number of private consumers contribute only half the amount of revenue.

Carnarvon: *Income Tax and Sinking Fund Instalments.*—Efforts to obtain repayment from the Treasury of the income tax deducted from the electricity works sinking fund paid by the National Electric Construction Co., have not met with success. To get over the difficulty, the Company has suggested that the undertaking should be transferred wholly to them, as was recently done in the case of the Surbiton Works, although another company was involved in that case. The suggestion is under consideration.

Chesterfield: *Proposed Extensions.*—Mr. S. L. Pearce, Chief Electrical Engineer to the Manchester Corporation, has presented a report upon the proposed extensions at the electricity works, and recommends that the existing site is a suitable one for the scheme.

Eastbourne: *Public Lighting Capital Charges.*—In his annual report for the year to March 31st Mr. J. K. Brydges, the borough electrical engineer, calls attention to the fact that as no public arc lamps and only a few public incandescent lamps are now lighted owing to the war, it is reasonable that the general district rates should be drawn upon to pay the interest on the £6,000 capital expenditure involved. If this is not done the rates are benefiting by £300 per annum at the expense of the electricity undertaking, which in normal times received £2,406 per annum revenue from the public lighting, as compared with £197 at the present moment. There was a loss last year of £911, compared with a profit of £2,228 in 1914-15. The accumulated profit brought forward from the previous year was £7,299, from which has been transferred £1,500 to reserve fund and £453 to renewals fund. Deducting also the loss for the present year, the balance carried forward is £4,435. A 1,250-kw. Ljungstrom turbo-alternator was put into service in June, 1915, and it is not without interest to note that in connection with the erection of this plant the work of removing the old foundation, a solid block of concrete containing 1,000 cubic feet, the construction of the new foundation and extension sump to the cooling pond, also the erection of the 14-in. iron circulating water, steam, and exhaust pipes, all electrical connections between the plant and the switchboard and the construction of the new engine-room floor around the plant, were carried out by the works staff without any outside assistance.

Keighley: *Half-Watt Lamps.*—In his annual report, the Borough Electrical Engineer, after pointing out the extent to which the lighting restrictions and the Summer Time Act have reduced the demand on the undertaking, says that the half-watt lamp is becoming more generally adopted, and that he anticipates a further reduction in the lighting revenue from the improvements which are being made in this particular type of lamp.

Kirkcaldy: *Proposed New Electricity Works.*—A proposal to obtain the advice of Sir John Snell upon a report by the Electricity and Tramways Manager advising the erection of a new electricity works immediately, as the present works are quite unable to cope with the demand, was rejected by the Corporation last week. The opinion was expressed that it is not advisable to go in for new undertakings at the present time. Mr. O. F. Francis expressed the opinion in his report that the time is opportune for laying out a modern station with large generating units on a more suitable site than the present one.

London: *Bethnal Green: Supply Commenced.*—The Council's electric supply scheme has been commenced, although only a limited supply is being given at present. Current is taken in bulk from the Stepney Council, and Bethnal Green thus loses the distinction of being the only borough in London in which a supply of electricity is not available.

St. Marylebone: Feeder Breakdown.—The Electricity Committee report a serious breakdown on the 14th inst., which lasted from 4 in the morning until 9 p.m. The damage was so great that the origin of the fault could not be discovered, but as the ground had not been disturbed for some time, it is assumed that moisture caused the trouble. Had the feeder protection device, contemplated prior to the outbreak of war, and abandoned owing to the difficulty of raising the money, been installed, it is very improbable that this fault would have occurred. The fusing took place in a congested nest of cables at the junction of Aybrook and Blandford Streets, the mains being laid nearly eleven years ago, and being very close together, owing to vaults under the premises adjoining the roadway. In order to avoid a recurrence of the trouble some of the cables are to be diverted and carried by another route at a cost of £1,100. In this way a similar breakdown would only affect half the system instead of the whole of the borough.

Mansfield: *Rate Relief.*—There was a net profit of £2,719 on the working of the electricity undertaking last year, of which £1,500 will be paid over to relief of rates, and the balance of £1,219 placed to the credit of the reserve fund.

Norwich: *Electricity Accounts.*—The total output last year represents an increase of 3·3 per cent. over the previous twelve months, notwithstanding that no current has been used for public lighting compared with 650,125 units previously. Considerable progress has been made with electric fires and radiators, and also in power supply, the units supplied for the latter purpose representing an advance of 19 per cent. The net profit was £4,503, of which £2,023 are to be placed to depreciation fund, bringing this latter to £8,000. The balance is to be carried forward. The average cost of coal was 20s. 3d. per ton, against 17s. 4d., whilst the prices for the current year will be higher still. Allowances to wives and families of employees on service absorbed £1,300, against £400. Regret is expressed in the Committee's report at the unsatisfactory conditions concerning the 2,000-kw. set, due for completion as far back as 1912, and the serious statement is made that it appears doubtful whether the machine will attain its guaranteed efficiency. Negotiations with the

makers are being carried on with a view to putting matters right. A 5 per cent. increase is recommended on the charges for current, and, in view of the advances in price made in various parts of the country, Norwich electricity consumers have no reason to complain.

Southampton: *Heavy Deficit.*—At the beginning of the year there was an estimated loss of £8,100 on last year's working of the electricity undertaking, and the Committee, on that basis, recommended a 10 per cent. increase in charges, which would have covered the loss. Unfortunately, however, the actual loss has been £6,020, and a further increase of 10 per cent. is now to be made.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The New South Wales Government Railways and Tramways Commissioners require an electric overhead travelling crane for the Zarra Street power house, Newcastle, N.S.W. Further particulars at 73 Basinghall Street, and tenders by September 30th.

Bradford.—In connection with the recent application for sanction to borrow £100,000 for new plant, the City Council has been informed that the Local Government Board is not prepared to sanction extensions not required for war purposes. For the present, however, the Board is willing for mains extensions to be carried out without special permission. The Council is endeavouring to obtain an interview with the Minister of Munitions on the subject.

London: *Poplar.*—Mr. J. H. Bowden, the Borough Electrical Engineer, recommends extensions to the mains in the central portion of the Borough, at an estimated cost of £3,123. In reporting the matter to the Council last week the Chairman of the Electricity Committee pointed out that important applications for supply have been received, but that they cannot be considered unless immediate steps are taken to increase the capacity of the distributing network.

Miscellaneous

Bolivia.—The British Vice-Consul at Oruro, says the *Board of Trade Journal*, reports that there is a shortage of many goods required by the mining industry. The greater part of the business in machinery and electrical requirements has hitherto been in German hands, but there is now an opening for United Kingdom manufacturers.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £120 to £124 (last week the same).

Lund Bros. & Co.—To meet the increase in their maintenance and repair department, Messrs. Lund Bros. & Co., of 49 Queen Victoria Street, E.C., have taken premises at 15 Cromer Street, Gray's Inn Road, W.C. Telephone No.: 2876 Holborn. The City office will be continued.

Pope's Employees and Wounded Soldiers.—The women and girls employed by Pope's Electric Lamp Co. (Hythe Road, Willesden) recently entertained 120 wounded soldiers at the Shepherd's Bush Empire, and generously paid all the expenses. Another party of 60 men have since been given an outing and tea in Kew Gardens, and a third collection has made it possible for another 60 wounded soldiers to be given a similar treat.

Agencies.—A Lyons firm wishes to represent United Kingdom manufacturers of electrical goods and apparatus. Further particulars at 73 Basinghall Street, E.C.

Partnership Dissolved.—F. A. Donnison and W. Sillem, trading as electrical engineers and contractors, 116 Great Portland Street, London, have dissolved partnership.

Increased G.E.C. Prices.—The General Electric Co. (London and Wilton, Birmingham), announce certain increases on their catalogue prices of low and medium tension switchgear, battery cut-in and cut-outs, high-tension switchgear, and switchboards.

APPOINTMENTS AND PERSONAL NOTES

The Executive Committee of the City and Guilds of London Institute have appointed Dr. W. H. Eccles, M.I.E.E., to the Professorship of Electrical Engineering and Applied Physics at the Institute's Technical College, Finsbury, rendered vacant by the recent death of Professor Silvanus P. Thompson, F.R.S. Dr. Eccles is at present University Reader of Graphics at University College, and is the author of a work on "Wireless Telegraphy and Telephony" and numerous papers and inventions on subjects connected with electrical engineering.

Mr. S. R. Mullard, of the Research Laboratory, Edison & Swan United Electric Light Co., Ltd., Ponders End, Middlesex, has been granted a temporary commission as Lieutenant, R.N.V.R., attached to the R.N.A.S. Mr. Mullard, who has been actively employed in connection with research work on the Ediswan "Pointolite" (nitrogen arc lamp), is being retained by the Ediswan Company, which will enable him to keep in touch with his laboratory work.

The Metropolitan Munitions Committee has addressed a letter to the St. Marylebone Borough Council expressing their thanks for Mr. A. H. Seabrook's assistance in the work of the Committee during the past year. Incidentally it may be mentioned that Mr. Seabrook's whole time is now devoted to the work of the Council, and that the proposal for him to take up a Commission (Electrical Engineering, June 1st, page 204) has been abandoned.

Capt. H. Gray, the Accrington Borough Electrical Engineer, who joined the Howitzer Brigade at the outbreak of war, has been stationed at Woolwich for some time, but is now employed in a munitions factory near Morecambe.

News has been received from the Western Front that Sec.-Lieut. Ralph Lodge, nephew of Sir Oliver Lodge, F.R.S., and prior to the war employed by the General Electric Co., is missing.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Yorkshire Electric Power Co.—The report for the June half year shows a nett profit of £13,550, compared with £9,873 in 1915, and £10,414 in 1914. The half-year's dividend on the 6 per cent. cumulative preference shares will absorb £4,787, but in view of the financial conditions arising out of the war and the heavy commitments which the company has had to incur due to the demands for munitions, the directors have deferred the consideration of a dividend on the ordinary shares until the end of the year. An important extension of the Thornhill Power Station is being made, and as a first installation a 6,000-kw. turbo-alternator will shortly be erected.

Crompton & Co.—The report for the year to March 31st shows an available balance of £37,950, and after meeting the seven per cent. Preference dividend, transferring £10,000 to special depreciation and £6,500 to general reserve, there is a balance carried forward of £10,479. It is not proposed to recommend a dividend on the Ordinary shares, having regard to the company's liability in respect of the Excess Profits Tax and also under the Ministry of Munitions.

Edmundsons' Electricity Corporation.—The net profit for the year to March 31st was £13,259, and after meeting Preference dividend a balance of £4,625 is carried forward.

Speaking at the annual meeting on Thursday, Mr. P. D. Tuckett said that the interruption in the record of steady progress which was being made prior to the war had resulted in an aggregate reduction of over £12,000 in the revenue from the associated concerns. Coal had cost £13,000 extra, and 364 highly trained men had joined the forces, a circumstance which had resulted in still further increasing the cost of production.

Companies Struck Off Register.—The following will be struck off the list of joint stock companies in three months unless cause is shown to the contrary: Anglo-German Wireless Syndicate; Bridlington Electrical Engineering Co.; Helis Cell & Accumulator Co.; United Electric Light & Power Supply Co.; Wireless Electric Light Co.

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SUMMARY

THE Home Office has issued a further report on the subject of electric signalling with bare wires in mines, with the object of defining the precautions necessary to render such signalling safe. Safety is said to be quite feasible, provided the battery power is limited and that the signalling instruments, whether bells or relays, comply with certain requirements (p. 294).

THE patents of special interest to mining electrical engineers, published during the past month, include some relating to coal-cutters, lamp igniters, and electric safety lamps (p. 294).

A PAPER on the economical production and utilisation of power at collieries was read by Mr. F. F. Mairet before the Midland Institute of Mining, Civil, and Mechanical Engineers. The author discusses in a general way the various kinds of prime movers, and the use of electricity for power distribution at collieries (p. 295).

AN additional type of miners' electric lamp has been approved in a Home Office order, which also imposes restrictions regarding the use of celluloid in mining lamp accumulators (p. 295).

OUR Questions and Answers page this week deals with the unstable running of some continuous-current machines when being tested by the Hopkinson method (p. 296).

SOME particulars are given of the local electric supply scheme just inaugurated at Holmfirth (p. 297).

COMMITTEES of the Institution of Electrical Engineers and the I.M.E.A. and Power Companies have been formed to consider the position of electric supply throughout the country. There is to be co-operation between the two Committees (p. 297).

AMONG the subjects of Patent Specifications published at the Patent Office on Thursday last were, incandescent lamps, X-ray apparatus, wireless telegraphy, and motor-car lighting. An appeal has been lodged against the Controller's decision to grant a wireless telegraph patent in spite of opposition. Licenses have been granted under a number of enemy-owned patents for magnetic separators. A flame carbon patent expires this week after a full life of 14 years (p. 298).

A NUMBER of books are reviewed on p. 298.

DESCRIPTIONS are given of some portable electric tools and fans, and brake magnets (p. 299).

A DEFICIT of £26,000 was incurred at West Ham last year.—The Bridlington Electric Supply Works were shut down 15 times last year in consequence of aircraft alarms.—The revenue at Glasgow last year increased by 30 per cent., and the working expenses by 47 per cent. (p. 300).

NEW plant is required at Worcester (£14,000); Rotherham (£50,000); mains and motors at Derby (£9,000); and transformers at Sydney (p. 300).

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE.

ORDERS FOR AUGUST, 1916, BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Headquarters and Range.—The Headquarters will be closed during August, except on Tuesday evenings. The range will be open on Thursday evenings only. On these evenings the Sergeant-Major will take charge and be responsible for the maintenance of order and discipline. Recruits are urged to take advantage of this arrangement for drill and shooting.

Instruction Classes.—Instruction classes at Regency Street will be held as usual for Platoons Nos. 9 and 10.

Camp.—The Camp at Otford will be available until August 31st. Members wishing to attend should enter their names at Headquarters on the sheet provided for the purpose. The cost will be about 3s. per day. Members should provide themselves with 2 blankets, knife, fork, spoon, plate, mug, and a spare pair of boots.

Entrenching.—As many members as possible should endeavour to attend the Sunday Entrenching Parades, in order that the work to be done may be completed as expeditiously as possible. Parade in Uniform, as usual, at Victoria Station (S.E. & C. Rly.) Booking Office, 8.45 a.m. Members are reminded that this work is of national importance, and, therefore, all who are able to put in Saturdays and occasional week-days are urged to do so. They are reminded that they can obtain railway vouchers from the booking clerk by showing their cap badges.

Enemy Lamp Firms.—The President of the Board of Trade has stated that steps are being taken to eliminate all German interest in the principal British registered companies which manufacture incandescent electric lamps.

Technical College Announcements.—A systematic course of instruction in electrical measurement and practical electricity for students proposing to enter the electrical engineering profession will be commenced at University College of North Wales, Bangor, in October.

Enemy Firms Wound Up.—An order has been made by the Board of Trade under the Trading with the Enemy Act for the winding-up of the business of electrical accessories merchant carried on by C. A. Muller, 10 Arcade, Westgate, Bradford. The Controller is Mr. W. Darrance, 12 Duke Street, Darley Street, Bradford.

Opening for Electrical Goods in Norway.—In consequence of the unprecedented rise in the cost of fuel in Norway, coal having risen from 30s. to 94s. per ton, the public are turning their attention to the possibilities of the greater utilisation of electricity, and the demand for electrical appliances of every kind is said to be rapidly expanding. According to a report of General E. H. Dennison, the U.S. Consul at Christiania, it is thought that coal will perhaps never return to its original price, and in any case the sale of electrical appliances is bound to increase. Reports from all over Norway are said to confirm the impression that the country is enjoying great prosperity.

The Board of Trade and Linking-up.—In the House of Commons on Thursday Mr. T. M. Healy asked the Secretary of the Board of Trade, in connection with the recent circular as to linking-up, whether consideration had been given to the expense which would be involved in carrying out the proposal to link-up electric supply undertakings, and whether legislation would be introduced to render this possible in cases where statutory authority would be required. Mr. Harcourt said that the question of expense had been recognised, but in issuing the circular the Board of Trade had not in mind large schemes of inter-connection involving heavy capital expenditure and a large use of material, but rather contemplated arrangements between undertakings whose areas of supply joined or nearly so. Legislation for this purpose he did not think was necessary, but should it appear to be so subsequently, full consideration would be given to it.

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

ELECTRIC SIGNALLING WITH BARE WIRES

THE Home Office has issued a report by Dr. R. V. Wheeler and Dr. W. M. Thornton on electric signalling with bare wires; so far as regards the danger of ignition of inflammable gaseous mixtures by the break-flash at the signal-wires. A previous report on battery-bell signalling systems (see ELECTRICAL ENGINEERING, Vol. XI., p. 197, May 6th, 1915) had already been submitted by Dr. Wheeler, describing investigations carried out at the Home Office Experimental Station at Eskmeals, and since then these investigations have been continued and extended, so as to embrace the whole subject of underground signalling by means of bare wires.

The previous report showed that, contrary to general expectation, the break-flash that occurs at uncovered signal-wires when a signal is given can, in the majority of cases, ignite inflammable gas, and must therefore be regarded as "open sparking," which is defined in the Regulations under the Coal Mines Act as sparking, which, owing to the lack of adequate provision for preventing the ignition of inflammable gas external to apparatus, would ignite such inflammable gas. At the same time, it was shown that the break-flash can be rendered innocuous. The object of the present report is to define the precautions necessary in order that the bare-wire signalling system shall be rendered safe. Given certain restrictions as to battery power, there are several ways in which safe and efficient bells and relays can be constructed. These are described in detail.

Discussing first the maximum battery power permissible under the Coal Mines Act—namely, 25 volts—the report says it is questionable whether it would be wise to reduce the voltage allowable from 25 to 15 or less. Even with 3 or 4 volts some types of bells at present in use are unsafe, whereas the introduction of "anti-sparking" devices would allow a battery at 25 volts safely to be used. While, therefore, no gain in safety would be experienced by stipulating a maximum voltage of, say, 15, the ringing efficiency of most of the bells would be seriously affected thereby. On the other hand, a battery of wet Leclanché cells at 25 volts has little greater danger than any battery necessary to give a reasonable working current.

The report goes on to discuss the question of relays, and shows that the operating efficiency of the commonest types of relays is greatly superior to those of most bells, a battery power of 10 volts in most cases allowing ample margin for the resistance of bad connections on the signal-wires. This superior battery efficiency is, unfortunately, discounted by the higher inductances of relays compared with bells, due to the larger number of turns of wire with which the relay magnets are wound. It thus results that though relays can be worked with a smaller battery than most bells, they have, in general, a lower "igniting-current" at which the break-flash on the signal-wires becomes dangerous. As regards present practice in respect of the use of relays, more particularly as regards the battery power usually employed, it appears from reports obtained from H.M. Inspectors of Mines that although in the majority of mines smaller batteries are employed to actuate relays than would be used for bells over the same length of line, yet, with few exceptions, the battery power is in excess of what is sufficient to give a dangerous break-flash at the signal-wires. The commonest types of relays are dangerous when used with a battery of more than four wet Leclanché cells, while the reports of H.M. Inspectors of Mines show that a battery of less than six such cells is used comparatively rarely.

Methods are described of rendering bells and relays safe. It is known that the dangerous nature of the break-flash that occurs when a bell or relay is included in the electrical circuit is in part due to the occurrence of self-induction which, when the circuit is broken, produces momentarily an abnormal voltage. Suitable methods of rendering bells and relays safe, therefore, are such as aim at minimising the effects of the highly self-inductive electromagnetic windings which are the essential features of bells and relays. It is possible, however, to construct good ringing bells and efficient relays without having recourse to special devices for overcoming the effects of self-induction. The chief factor in rendering the break-flash at the signal-wires dangerous is the amount of current available. Given a definite battery power that is not to be exceeded, the resistance of the bell or relay can be so proportioned that the maximum current obtainable on short-circuit does not exceed the "minimum igniting-current" for the system.

The authors give consideration to the question of current supply, and make reference to four methods which are in use for the supply of current to signalling circuits—namely, primary batteries, storage batteries, A.C. or D.C. motor-generators, and transformers. An objection to the last-named is that, in the event of failure of the insulation between the primary and secondary windings, the pressure of the power circuit might be transmitted to the signalling circuit. A central battery or generator system is advantageous from the point of view of simplicity of subdivision for different circuits, but such systems require precautions to be taken to avoid heavy currents being obtained on giving a signal; and, from what has been said regarding the necessity of limiting both the amount of current in the circuit and its inductance, if the danger of ignition of inflammable gases at the signal-wires is to be eliminated, it will be realised that the advantage so far as safety is concerned lies with the wet Leclanché primary battery as the source of current.

Conclusions.—As a result of their investigations the authors draw the following conclusions :—

(1) The bare-wire system of electrical signalling as commonly employed can be rendered quite secure from any danger of the ignition of inflammable gases by the break-flash at the signal-wires or at the contacts of the signalling instruments.

(2) In order to procure safety, it is necessary, in the first place, to limit the battery power that is to be employed on any one circuit; and, in the second place, to ensure that the signalling instrument, whether bell or relay, shall comply with certain requirements.

(3) The present statutory voltage, 25, sets a reasonable limit to the battery power provided that wet Leclanché cells be used. Systems in which the battery used consists of dry primary cells or of secondary cells, or in which continuous or alternating current generators are employed, could be rendered safe if, in addition to the use of "anti-sparking" devices embodied in the signalling instruments, sufficient non-inductive resistance were permanently included in the bell circuit.

(4) The signalling instruments, bells or relays, should have flame-tight covers, and must be so constructed that when included in a circuit with a battery at 25 volts the break-flash produced when bare signal-wires are separated after giving a signal is incapable of igniting an 8 per cent. methane-air mixture. There is no difficulty in constructing either bells or relays to conform with these requirements.

ELECTRICAL MINING PATENTS OF JULY

AMONG the patent specifications published during the last month the following deal with application of electrical engineering to the working of mines :—

F. W. Hurd, in No. 12,336, of 1915, describes a special design of electric coal-cutter for use in very thin seams. In order to keep down the headroom to a minimum, the motor is so placed that its vertical dimension coincides with the vertical dimension of the gear-head, and a lay shaft driven from the motor shaft drives the gear-head through bevel gear.

An improvement in the flame-tight construction of a cover of an electrical igniter for miners' oil safety lamps is subject of No. 13,040, of 1915, of R. Lambourne, and a design of electric safety lamp is described by G. H. Bellamy in No. 13,807, of 1915. In this lamp the portion including the contact plate is resiliently mounted in the lamp-head to ensure good contact with the battery terminals by means of a resilient metal washer interposed between the flanges of the lamp-head and the glass.

ECONOMICAL PRODUCTION OF POWER AT COLLIERIES

In a paper on the economical production and utilisation of power at collieries, read before the Midland Institute of Mining, Civil and Mechanical Engineers, Mr. F. F. Mairet discussed the general question of the use of electricity for power distribution. Speaking first of prime movers for the generation of power, he recapitulated the various forms which these take, from the horizontal slow-speed engines, belted to generators, to the modern high-speed direct-coupled type. Belt- or rope-driven sets, he said, cannot be recommended, owing to their low efficiency, inability to take high-load peaks, cost of upkeep, and space occupied. Radiation losses are considerably higher for unit power as compared with the high-speed sets, on account of the larger heated surface which must be exposed to the atmosphere on account of the lower speed. Vertical high-speed reciprocating sets have in the last few years reached a high state of efficiency and reliability, and form the most efficient steam-driven prime mover up to about 300 kw. The makers have designed these engines that reversal of the stresses is so gradual that forced lubrication is sufficient to keep the bearing surfaces from coming into contact.

For powers above 500 kw., the most suitable and economical steam-driven prime mover is the turbine coupled direct to its electric generator. Present-day method is practically the result of a compromise between such factors as steam economy, strength, cost of construction, size, weight, factor of safety, leakage losses, and steam temperature. Up to the present, impulse turbines have met with great success on account of their simple form, which is not liable to distortion with the pressure and temperature necessary for their efficiency; but it would appear that the reaction turbine should give better results, provided it were possible to use steam of the same temperature as the impulse turbines. Theoretically, the reaction turbine is the best, but the impulse turbine has the advantage that there are no guide-blades to cause friction, and it occupies less space.

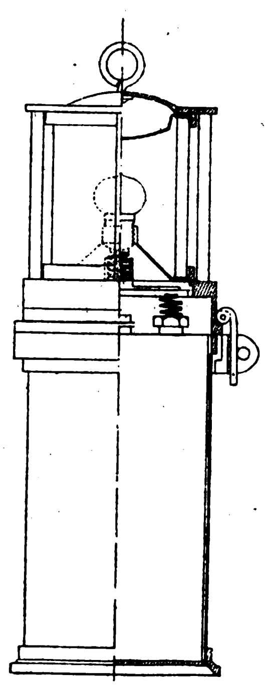
The advantages of generating power on a large scale have long been appreciated, and in this direction it has been demonstrated that central stations are generally able to provide power at a very low figure. This advantage must, however, be to a certain extent discounted by reason of the transmission losses which occur to a greater or less extent, depending upon the distance and power factor. Transmission may be divided into two classes, the "direct method," in which the prime mover which develops the electrical energy is coupled direct to the machine or machines it operates, as is usual with direct-current systems, and the "indirect method," in which the pressure or nature or both are transformed. For certain purposes, direct current has many advantages over alternating current, as in cases such as hauling, or any duty where a high starting torque or variable speed is required, but it has the disadvantage that a commutator, with the attendant risk of sparking, is necessary. Of late years three-phase alternating current has been preferred, as it is possible in the case of squirrel-cage motors to have an open type of motor, which, under normal working, is free from all sparking trouble. Alternating current, moreover, lends itself readily to transformation as regards voltage while still retaining the same periodicity by means of static transformers.

Experience has proved that where a number of induction motors and static transformers are used the power factor is lowered and a lagging current is set up in the mains, particularly when motors have been generously proportioned and are lightly loaded. This lagging current decreases as the load on the motor increases, but it is a serious loss with most power installations. To neutralise the resulting loss, the most usual method is to couple a synchronous motor across the mains, and to over-excite it until the power factor reaches the desired amount.

In large central power stations feeding a large area the transmission losses are naturally greater than if the same area were fed by a number of smaller stations, and in view of the waste heat or coke-oven gas available at collieries, it is evident that much economy might be effected by linking up a number of power stations and collieries. Taking, for instance, the district round Sheffield, Barnsley, and Wakefield, if all the collieries in this area were linked up to the central power station, fuller use might be made of each generating plant, and, by reason of the larger amount of power pooled, high load peaks would have less effect on the system. There would not be the same necessity for spare plant, as, in the event of a stoppage, power could be drawn from the mains, and a surplus of power finds its way to the power company's mains, and finds a market. The cost per unit for inflowing and outflowing current could be adjusted so as to preserve equilibrium at any desired point. Charts of the load factor obtaining with various industrial undertakings show that their combined load on the generating plant is less than the sum of their maximum loads.

MINERS' ELECTRICAL LAMPS

A new Home Office order approves the following type of miners' electric safety lamp (No. 1) made by Messrs. W. E. Teale & Co., Ltd., Swinton, Manchester. The general construction of the lamp is shown in the figure.



The case may be of steel, brass, or aluminium, provided with a securely riveted or soldered brass screwed locking ring. The accumulator terminals are fitted with rigid springs carrying rubbing brass contacts. The construction of the accumulator is such as to prevent escape of the liquid whatever the position of the lamp, whilst allowing the escape of the gas generated by chemical action. The cover forms a flame-tight connection with the case, and consists of a middle base ring of brass or steel carrying an aluminium or steel crown supported by four or more brass or steel pillars. The middle base ring is screw-threaded internally to take a fibre, wood, or glass retaining plate. A stout protecting glass forms flame-tight connections with the crown and retaining plate by washers of asbestos or other suitable material. The glass retaining plate also carries the lamp-holder and an insulated electrical contact piece. An efficient locking device secures the cover to the case, consisting of a lead rivet lock, with a hinged hasp or lug securely attached to a sliding band on the cover, and a staple or lug securely attached to the case; a vertical lug lock; or a magnetic lock.

The approval is subject to certain conditions, among which are the following:—That the total weight of the lamp is not more than $5\frac{1}{2}$ lbs. That the lamp shall be capable of maintain-

ing a light of not less than 1 candle-power all round in a horizontal plane throughout a period of not less than 9 hours, and also of giving a light of not less than 1·5 candle-power over an arc of 45° in a horizontal plane.

All approved electric safety lamps are now required to conform to the following requirements, and the description of each lamp is amended accordingly :—No celluloid, xylonite, or other material liable to be ignited by the spark on making or breaking contact, or on short circuit shall be used in proximity to the terminals : Provided that as regards lamps taken into use in mines on or before 1st December, 1915, this requirement shall not come into force until 1st January, 1918. The use of terminals which can be bent over, such as flexible spring terminals, is prohibited.

The following is a complete list of the miners' electric lamps approved up to the present by the Home Office :—

For General Use.—1, Bristol, Type B.T. 4 V. (Bristol Electric Safety Lamp Works); 2, B.A.C. (British Accumulator Co., Ltd.); 3, "Ceag" ("Ceag" Miners' Supply Co., Ltd.); 4, Turquand-Kingsway (General Electric Co., Ltd.); 5, Gray-Sussmann, Nos. 3 and 4 (W. E. Gray); 6, Manley and Sandy (M. & S.) (Manley and Sandy, Ltd.); 7, Joel-Fors, Type 403 M (John Mills and Sons); 8, Oldham (Oldham and Son); 9, Pearson (Pearson's Electric Miners' Lamp Co., Ltd.); 10, Thomson-Rothwell (Rothwell and Co. and The Thomson Co.); 11, Rothwell, No. 3 (J. H. Rothwell and Co.); 12, No. 1 Electric (W. E. Teale and Co., Ltd.); 13, Varta (Tudor Accumulator Co., Ltd.); 14, Wolf, Alkaline, Wolf, Lead, and Wolf No. 2 (Wolf Safety Lamp Co.); 15, Worsnop (Worsnop and Co., Ltd.).

For Use by Officials or for Special Purposes only.—1, Bristol, Type B.R. 4 V. (Bristol Electric Safety Lamp Works); 2, Float Patent (Float Electric Co., Ltd.); 3, Joel-Fors Electric Inspection Lamp, Type 303 C., and Joel-Fors Electric Hand Lamp, Type 403 H (John Mills and Sons); 4, Oldham "Emergency," "Oldham" Shaft and Roadway, Types "A" and "B" (Oldham and Son); 5, Varta, Type 2 Et 4 (Tudor Accumulator Co., Ltd.); 6, Wolf Rescue, No. 2 (Wolf Safety Lamp Co.).

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

Questions : ***We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.***

Answers : ***A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.***

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,505.

What sizes of cable should be used to wire for stator and rotor of a 10-h.p., 440-volt, 3-phase, 50-cycle, star-connected, slip-ring motor—five minutes' rating? Longest run, 15 yards. What current would the stator carry at 50 per cent. overload, and would current increase in proportion to load? What current is the rotor likely to deal with at this overload? The cable is to carry 50 per cent. overload for 5 minutes.—A. C.

(Replies must be received not later than first post, Thursday, Aug. 10th.)

ANSWERS TO No. 1,503.

It was desired to test two shunt-wound interpole dynamos by the Hopkinson method, with separately excited shunts. It was found impossible to get them running steadily, for as soon as the "dynamo" field was slightly weakened to increase the loading of the combination, the current and speed rose very rapidly. Explain cause and remedy.—Nomad.

The first award (10s.) is made to "Flash" for the following reply :—

The question does not state exactly which method of Hopkinson test was applied, whether the losses were accounted for by external mechanical power driving on the shaft, or by electric current from an external supply. From the fact, however, that the set tends to run away it appears that the latter method was adopted. "Nomad" states that to increase the loading of the combination the "dynamo" field was slightly weakened; this is wrong, because in order to increase the loading on the set it is necessary to either weaken the motor field or strengthen the generator field. The increase in current and speed may be due to several causes : (1) The brushes may not be in the neutral, but in a backward position, thus the speed would tend to rise with an increase in load beyond that due to the weakened field; this would again bring more load on, due to the fact that the dynamo would generate a higher voltage and increase the driving current. The obvious remedy is to push the brushes forward. (2) This may be due to an error in the design. If the interpole is wound with more turns—say, 20 or 30 per cent.—than the correct number required to give sparkless commutation, then with a small air gap the interpole on heavy loads will distort and counteract the main flux to such an extent that the speed will be considerably increased. This is first noticed by the fact that the motor begins to "hunt," until violent oscillations are reached, and the protective devices act. The easiest remedy for this trouble is to push the brushes forward, as in the first case. (3) When machines are undergoing the Hopkinson test they are very sensitive to any variation, and the stages of resistance introduced into the motor field may be too great, thus suddenly reducing the field current to such an extent that the motor tends to race, and repeat the effect stated in the first case.

The second award (5s.) is given to "W. H." for the following :—

There are three possible reasons for the running away and overloading of the machines undergoing Hopkinson test. If the machine which is motoring happens to have backward lead to the brushes, weakening the field would always tend to produce instability. In any case, the motor would speed up and correspondingly the generator, thus increasing the load on the sets. This extra load will strengthen the commutating pole flux, and as this, owing to the backward lead of the brushes, will further weaken the main field, more speeding up and overloading will take place, until eventually the circuit-breaker trips.

It may also be backward lead on the generator brushes giving a compounding effect to the generator together with a slight instability on the motor.

Or, thirdly, it may be due to over-compensation on the machine which is operating as a motor. The effect of the commutating pole flux being too strong would be similar to the effect produced by backward lead to the brushes.

The remedies are obviously to carefully check the brush position of both machines, particularly the "motor," and to check the amount of compensation on the commutating poles. If over-compensation is present, the commutating field winding may have a diverter fitted or a few turns removed. The third reason given is the more likely one, as brush position is usually determined carefully by a testing department. It is presumed that "Nomad" has reversed the commutating poles on the machine which is "motoring," as it is to be noted the machines were designed as generators.

Electrical Engineering in Russia.—The *Elektrotechnische Zeitschrift*, in a recent issue, gives what purports to be a quotation from a Russian paper suggesting that any attempts to make Russia independent of the German manufacturing industry after the war are foredoomed to failure, because Russia does not possess sufficient coal of its own. It is, perhaps, almost unnecessary to point out that this is an argument in favour of the British development of Russian markets. It is remarkable how long it is taking Germany to realise that, to the Allies, everything German will possess a taint for many generations after the war.

The Russian Language.—We have received from Leopold B. Hill (2 Langham Place, W.) a copy of a little book by S. J. Luboff, containing an elementary course in the Russian language, which teaches a certain amount of conversational Russian by means of pictorial aids to memory, and contains an outline of Russian grammar and a vocabulary of useful words forming an easy introduction to a language in which more and more interest is bound to be taken as our commercial relations with our great ally develop.

ELECTRIC SUPPLY AT HOLMFIRTH

THE new Electricity Works of the Holmfirth Urban District Council were officially opened on July 15th. The question of lighting the town and district by electricity had been under consideration since September, 1911, and a Provisional Order, dated August, 1912, was obtained. After this negotiations were opened with the Yorkshire Electric Power Co. with a view to obtaining a bulk supply, but that scheme was dropped. The Council, however, was determined to see the project through, and they accordingly decided to establish an electricity works of their own. An Electricity Committee, having as Chairman Mr. E. Overend, was accordingly appointed. Tenders for the generating plant and complete installation were called for, to the specification of Mr. A. B. Mountain, of Huddersfield, and a contract was awarded in October, 1913, to Messrs. T. W. Broadbent, Ltd. (Victoria Electrical Works, Huddersfield). The works are situated near the centre of the town, and provision has been made for extensions. Continuous current generators, driven by gas-engines supplied with producer gas, and working in conjunction with a small battery, are employed.

The gas-producing plant is in a shed adjoining the station, and forms a part of it, and consists of two open-hearth suction producers of Messrs. Crossley Bros.' latest design. Pipe connections are provided, by which either engine can be run from either plant. The engines are by Messrs. Crossley Bros., and are of the horizontal type, developing 190 b.h.p. (maximum) and 95 b.h.p. (maximum) respectively, both running at 190 r.p.m. The larger one is a double-cylinder engine, whilst the smaller one has only one cylinder. The cylinders are all of the same size, which obviates the need for holding a large stock of spare parts.

The electric generators are of Messrs. Broadbent's own manufacture, and are belt-driven. The larger one has an output of 100 kw. at 625 r.p.m., and the output of the other is 60 kw. at 640 r.p.m. Both generators are of an improved design, having auxiliary poles, making them particularly sparkless, and are wound for 460 volts.

The "three-wire" system of distribution is employed, with a declared pressure of 440 volts across the outers, and the neutral earthed. A rotary balancer is employed to maintain the electrical equilibrium between the two sides of the system. There is a small battery, which is large enough to deal with the night load, thus permitting the generators and balancer to be stopped. The battery, which is by the Chloride Electrical Storage Co., Ltd., consists of 250 "H.L.G. 3/5" type cells of the "Plantide" form in glass boxes. Sufficient margin has been allowed in the dimensions to meet with the possible requirements of additional capacity at some future date. The battery is capable of discharging at the rate of 104 amperes for one hour, 34 amperes for five hours, or 20 amperes for ten hours. For charging the battery a three-wire motor-driven booster is employed. The switchboard, of enamelled slate, in an angle iron frame, is 13 ft. 6 in. wide by 6 ft. high. There are three generator panels, including one spare, one battery panel, one balancer panel, one booster panel, four feeder panels, and two street-lighting panels.

The distribution has been carried out by means of overhead mains on steel poles in the centre of the town and on wooden poles in the outskirts. All this work has been carried out in a specially secure manner suited to the peculiarities of Holmfirth, whose acute angles and steep hills present problems requiring more than an ordinary amount of thought and attention. The poles serve also as standards for the street-lighting fittings and lamps, the street lamps being controlled by automatic time switches, which are affixed to the poles where required. House services are tapped off the overhead wires, and the tappings are taken into the consumers' houses (usually in the upper storey) through porcelain leading in tubes. The charges for current are 6d. per unit for lighting and 2d. per unit for motive power, heating, or cooking, and they are not unreasonable in view of the present high prices of fuel, etc. Already there is a fair demand for current lighting purposes, and if the demand grows, as it is expected to, the undertaking should, under the capable management of Mr. A. C. Bott, the Engineer to the Council, prove a practical success. The capital charges are not excessive, and it is likely that the ratepayers will in time be rewarded for their enterprise. We are indebted for the above particulars to Messrs. T. W. Broadbent, Ltd., who, as already mentioned, were the main contractors for the whole scheme, and who themselves manufactured the generators, boosters, etc., and constructed the switchboard.

PRESENT AND FUTURE POSITION OF ELECTRICITY SUPPLY IN GREAT BRITAIN

IN our issue for July 6, p. 255, we announced that the Institution of Electrical Engineers had appointed a Committee to consider the suggestion made in Mr. E. T. Williams's paper last session as to the present and future position of electricity supply in Great Britain.

In the course of a paper read at the I.M.E.A. annual meeting on June 22 (Electrical Engineering, June 29, p. 244), Mr. H. S. Ellis, of South Shields, suggested the appointment of a committee representative not only of the larger but the smaller electric supply undertakings throughout the country, with power to co-opt members of other scientific societies. A decision to appoint such a committee was come to, we believe, on June 23rd, the announcement of the Institution of Electrical Engineers' Committee being made a week or so later. The I.M.E.A. Committee, however, is a joint one, representing municipal electric supply authorities and power companies, through the respective associations—viz., the I.M.E.A. and the Incorporated Association of Electric Power Companies.

The two Committees are constituted as follows:—

I.E.E. Committee: R. A. Chattock (Chief Electrical Engineer, Birmingham, Chairman; C. P. Sparks (President I.E.E. and Chief Engineer County of London Electric Supply co.); C. H. Merz (Newcastle-on-Tyne Electric Supply Co.); S. L. Pearce (Chief Electrical Engineer, Manchester); G. W. Partridge (Chief Engineer, London Electric Supply Corporation); T. Roles (Chief Electrical Engineer, Bradford); W. B. Woodhouse (Engineer and Manager, Yorkshire Electric Power Co.).

Joint Committee of I.M.E.A. and Power Companies.—I.M.E.A. members: J. H. Bowden (Chief Electrical Engineer, Poplar); R. A. Chattock (Chief Electrical Engineer, Birmingham); W. W. Lackie (Chief Electrical Engineer, Glasgow); S. L. Pearce (Chief Electrical Engineer, Manchester); H. Faraday Proctor (ex-officio) (Chief Electrical Engineer, Bristol, and Hon. Sec. I.M.E.A.); T. Roles (Chief Electrical Engineer, Bradford).

Power Company Members: W. A. Chamen, Chairman, (Engineer and Manager, South Wales Electrical Power Distribution Co.); J. S. Highfield (Consulting Engineer, Metropolitan Electric Supply Co.); C. H. Merz (Newcastle-on-Tyne Electric Supply Co.); D. A. Starr (Engineer and General Manager, Clyde Valley Electrical Power Co.); A. de Turckheim (ex officio) (Sec. Incorporated Association of Electric Power Companies); W. B. Woodhouse (Engineer and Manager, Yorkshire Electric Power Co.).

We are informed that a conference has taken place between the two Committees in regard to co-operation between them. Was there, however, any real necessity for two Committees to deal with the same matter? That this has been realised is suggested by the appointment of two members common to both Committees as intermediaries, so that the two Committees will be in continuous touch with each other's work—a rather cumbersome method.

It has also been agreed that the I.E.E. Committee will devote its attention to the question of electricity supply from the point of view of the requirements of the country as a whole, and will deal with the engineering aspect of the matter; while the Joint Committee will go into more immediate questions of organisation and linking-up of existing undertakings, etc.

Thus some of the difficulties of having two Committees are avoided; but it would appeal to most people as a more practical and expeditious method to have had one committee with sub-committees.

Science and Industry.—The value, and, indeed, the necessity of research work as a factor in industrial progress is now becoming generally recognised in this country. This recognition has been somewhat tardy, but it is none the less gratifying, and its ultimate effect cannot fail to be far-reaching. It is therefore of interest that the North-East Coast Institution of Engineers and Shipbuilders has recently appointed a Research Committee, and that the latter has already made a start with its work by acceding to the request of a well-known firm in the North to investigate and carry out exhaustive tests of apparatus, having for its object the more economical production of power by marine steam engines. This is the first of the influential technical institutions actively to promote the progress of the industries with which members are associated by officially making and recording tests of new apparatus developed by them.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published July 27th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

17,022/14. **Incandescent Lamps.** Julius Pintsch A.G. A filament support in which the only points of support are arranged between the ends of each rectilinear portion of the filament. (Two figures.)

9,476/15. **Incandescent Lamps.** B.T.-H. Co. (*G.E. Co., U.S.A.*). A machine for winding wire into fine helices as used for metal filament lamps of certain types, with a counting device actuating an electrical control gear enabling a series of filament coils to be made from a continuous wire kept apart by lengths of uncoiled wire. (Six figures.)

9,690/15. **X-Ray Apparatus.** B.T.-H. Co. (*G.E. Co., U.S.A.*). A method of working X-ray or other electron discharge tubes in which an intermittent electrostatic field is established radially about the cathode in synchronism with the periodicity of the impressed voltage of sufficient value to reduce or suppress the electron discharge. During the period when current flow is desired, near the voltage peaks of each current wave, the intensity and, if desired, the polarity, of the field is changed to promote the electron discharge. (Three figures.)

11,641/15. **Car Lighting.** F. W. Rixon. A combined exhaust silencer and thermopile in which the waste heat of the exhaust is used to generate current for car lighting or charging accumulators. (Two figures.)

11,831/15. **Wireless Telegraphy.** Marconi's Wireless Telegraph Co. and E. T. Trost. In a transmitter, the combination of means for producing in the aerial two or more sets of oscillations which normally are of opposite phase and neutralise each other, and a microphone adapted to control the phase and magnitude of one set. (One figure.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: W. T. Henley's Telegraph Works Co. and Harris. [Junction box filling] 14,496/15.

Electrometallurgy and Electrochemistry: Jones [Anodes for electroplating] 17,328/15; Haddan (*Soc. Française des Electrodes*) [Connection of furnace electrodes] 18,222/15.

Ignition: Neuland [Combined ignition and lighting system] 9,908/15.

Incandescent Lamps: Casotti [Incandescent lamps and holders] 10,121/15.

Switchgear, Fuses, and Fittings: Horstmann and Horstmann Gear Co. [Time switches] 10,067/15; House [Switch controlling devices] 10,938/15; Stripp [Cord grips] 11,322/15.

Telephony and Telegraphy: Soc. Marius Latour et Cie. [High-frequency transformers] 26,934/13.

Miscellaneous: Trautmann [Pocket lamps] 9,934/15; Read [Electric clock] 9,981/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [X-ray tubes] 10,454/15; Codd [Contact breakers for induction coils] 14,582/15; Marks (*Interstate Electric Novelty Co.*) [Pocket lamps] 16,797/15; E. Bachelet [Electromedical apparatus] 469/16 (*100,800*).

The following Specification is open to Inspection at the Patent Office before Acceptance, but is not yet published for sale.

Dynamos, &c.: British Westinghouse Elect. & Mnf. Co. [Rotary converters] 9,541/16 (*100,847*).

Opposition to Grant of Patents

An appeal has been lodged against the controller's decision to grant a patent on the following application in spite of opposition:—

11,655/15. F. K. Vreeland. A system of wireless telegraphy in which undamped oscillations are generated in a circuit containing a mercury vapour arc with a restricted area of high energy transforming capacity.

Application for Suspension of Enemy Patents

14,082/08 and 29,230/1 Ullrich; 17,459/09 Lake (*F. Krupp A.G. Grusonwerk*), and 29,201/11, 29,224/11, 4,595/13, 14,426/13, 14,427/13, and 24,353/13 F. Krupp A.G. Grusonwerk. **Magnetic Separators.** Licences have been granted in respect of the application of Edgar Allen & Co., Ltd., and the Rapid Magnetting Co., Ltd., regarding these patents.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

17,406/02. **Arc Lamp Carbons.** Flame lamp carbons with separate longitudinal channels filled with certain mineral substances.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors and Transformers: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Induction motor control] 8,764/07 and 551/09.

Heating and Cooking: E. C. R. Marks (*J. Roberts*) [Combined transformer and water heater] 8,093/08.

Incandescent Lamps: Deutsche Gasgluhlicht Ges. [Filament supports] 19,562/07.

Switchgear, Fuses and Fittings: B.T.-H. Co., E. B. Wedmore, and J. Whitcher [System of earthing neutral points of three-phase alternators] 8,979/09.

Traction: M. Cummings [Braking controllers] 8,501/04; W. Cooper [Multiple unit train control] 8,402/06.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

British Destiny: The Principles of Progress. By D. N. Dunlop. 133 pp. 7½ in. by 5 in. (London: The Path Publishing Co.) 3s. 6d. net; abroad, 3s. 9d.

Although the Secretary of the B.E.A.M.A. indulges in a good deal of philosophic reflection as a seeker after an ideal social State, there is, nevertheless, a distinctly practical and constructive vein throughout this book. It may be regarded as part of the propaganda to teach Governments and the public the importance of science and industry to the national organism. At the same time, those who are endeavouring to bring this co-ordination about are themselves not altogether without need of organisation. The final chapter, dealing with a national industrial federation, shows the weakness here, although the ideal of labour, capital, manufacturers, agriculturists, scientists, and educationists, all working together in perfect harmony, imposes rather a strain on the imagination, human nature being no more likely to change in the future than it has done in the past. Much, however, can, and no doubt will, be done in the direction suggested by the author. Altogether the book makes thoughtful reading.

Employers and Workmen. A Handbook Explanatory of their Duties and Responsibilities under the Munitions of War Acts, 1915 and 1916. By T. A. Fyfe. 95 pp. 9 in. by 5¾ in. (London: William Hodge & Co.) 2s. 6d. net; by post, 2s. 8d.

With the never-ceasing flow of Acts, Orders, and Regulations that has been going on since the war began, something in the nature of a popular explanation of the present relations between employers and employees was clearly necessary, and Sheriff Fyfe, of Glasgow, himself Chairman of the Glasgow Munitions Tribunal, has succeeded well enough in doing this. The book does not pretend to do more than elucidate the Munitions of War Act of 1915, amended by the Act of 1916, and gives as appendices the text of the Act with amendments, together with the rules regarding the limitation of profits and leaving certificates. Unfortunately, things have been moving so rapidly of late that already certain modifications have been made, as, for instance, the change in the method of determining the amount to be allowed for depreciation in controlled factories as laid down by the Finance Act of 1916. These, however, are only details, and do not detract from the usefulness of the book.

"SUN" PORTABLE TOOLS AND FANS

We illustrate some of the portable tools and fans dealt with in two lists just published by the Sun Electrical Co., Ltd. (118–120 Charing Cross Road, W.C.). Fig. 1 represents a portable electric grinder fitted to the tool post of a lathe and finishing a hole to dead size. This grinder is fitted with a 1/12 h.p. motor running at 10,000 r.p.m., and can be run from any lighting point, being sent out complete with stout workshop flexible cord, fire-proof adapter, and metal-cased switch. The motor will operate on either direct or alternating

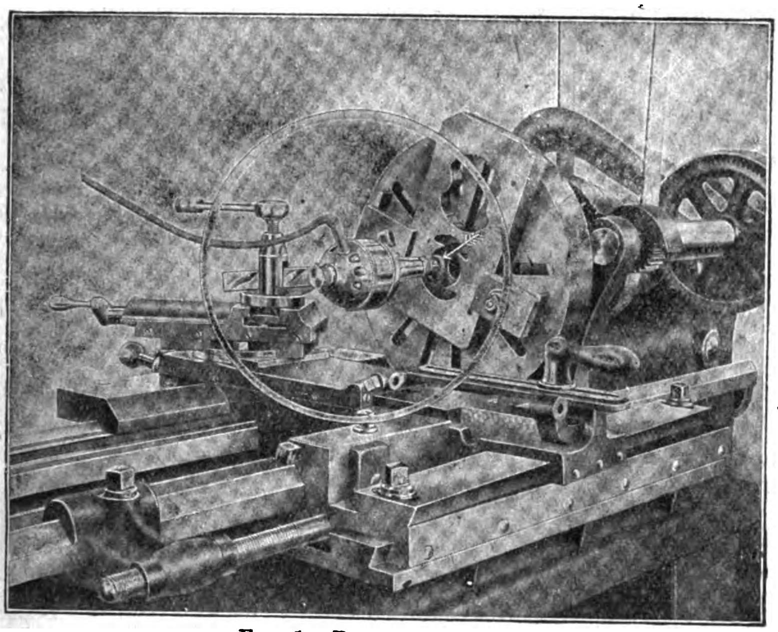


Fig. 1.—Portable Grinder.

current circuits, and the fixing arm, as will be seen, is designed for fitting into the slide rest of ordinary lathes.

Fig. 2 illustrates a portable electric drill, in which great care has been given to the small details that really matter. Large brushes, plenty of ventilation, and reliable oiling all ensure freedom from breakdown, whilst aluminium is used where possible, making the tool light to handle. The switch is placed just below the handle, thus being easily accessible, the one switch being capable of stopping, starting, and reversing. The motor runs on both D.C. and A.C. circuits. The firm also lists a portable electric buffer, which weighs only 8 lb., which is extremely useful for dealing with work too large to be taken to the ordinary buffing machine, whilst another portable electric drill has its spindle offset to facilitate drilling in corners.

Electric fans are described in a separate list, and Fig. 3 shows a ventilating fan fitted with beedle or propeller blade. Tables of speeds are given for both alternating and direct current. D.C. fans, 12 to 18 inches diameter, have totally

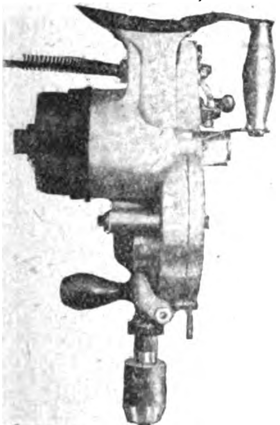


Fig. 2.—Portable Drill.

Fig. 3.—Ventilating Fan with Propeller Blade.

enclosed motors, with ball thrust bearing, for working with horizontal or vertical spindle; 24 inches and upwards have ventilated enclosed motors. A.C. fans, from 18 inches diameter upwards, have induction-type motors with short-circuited rotors. There are also listed desk fans, ceiling fans, and back-draught shutters and regulators.

A large number of these portable tools and fans have been supplied to various munitions factories, where, needless to say, they have proved particularly useful, having regard to the high speed at which work in these factories has to be carried on.

BRAKE MAGNETS

One of the most complete lists that we have seen dealing with a special range of apparatus is a new pamphlet relating to totally enclosed brake solenoids, which has been published by George Ellison (Victoria Works, Warstone Lane, Birmingham). These have an adjustable dash-pot action to apply the brake gradually and release it freely, and are made series or shunt wound for continuous currents up to 650 volts and 300 amperes. They are suitable for any purpose requiring a definite direct pull through a limited stroke. The simple but substantial mechanical design is fully described in a detailed specification, and we note that the shunt wound solenoids are wound with enamel-covered wire, with the layers separated by moisture-proof, oiled paper. The shunt coils are in all cases wound for the live pressure, and no external series resistances are required. The question of discharge resistances has been carefully gone into; with shunt coils these can be dispensed with where the controller is fitted with an extra finger for the solenoid; but with series coils they are almost invariably required. The method of intermittent rating employed is fully explained, and full particulars are given to enable customers to state their requirements, so that a suitable design of magnet can be selected.

In the case of each of the five sizes a set of curves is given, showing the equivalent for each of the three ratings employed (15, 30, and 60 minute) of the time in use and out of use, which will cause the temperature to rise to and remain at normal if the cycle is repeated continuously. Other curves show the times which will cause the temperature to rise and remain at 50 per cent. more than normal and the number of times this more severe cycle must be repeated to raise the temperature from normal to their value. The curves, which are drawn separately for the shunt and series designs, can also be used in the latter case to show the extent to which a magnet may be overloaded with safety as regards current. The prices, and currents taken for different pulls and strokes are set out in a table for each size. Full details of weights, dimension, and alternative methods of mounting and cable entry fittings are given, and prices for spare parts, extras, and accessories.

A Sensitive Magnetometer.—A Paper on this subject by Dr. P. E. Shaw and Mr. C. Hayes was read recently before the Physical Society. A torsion balance of extreme delicacy carries a pair of purest silver balls, each 3 gm. weight. A solenoid with horizontal axis passing through one of the silver balls is brought close to the balance. On exciting the solenoid, divergent fields of known strength are obtained in the region of the ball. The resulting attraction of the ball to the solenoid is shown by a mirror reflecting a distant scale to a telescope. The couple on the torsion beam required to produce 1 mm. scale deflection is $4{\cdot}5 \times 10^{-7}$ dyne cm., and this torsion balance is 10^6 times as sensitive as any known to have been used previously in this kind of work. The results of these experiments are :—The magnetic properties of the silver are ascertained even for weak fields of 1–10 gauss. The silver has a pronounced activity; this effect being presumably due to the small trace of iron impurity. The relation of susceptibility of the silver to the field used is found. The susceptibility of each of the constituent materials (*a*) pure silver, (*b*) residual pure iron, appears to be greatly modified by the presence of the other material.

Thermo-electric Properties of Fused Metals.—A Paper was read by Mr. C. R. Darling at a recent meeting of the Physical Society describing an investigation into the thermo-electric properties of fused metals, having for its object the production of a thermo-electric pyrometer with a liquid element. If such a pyrometer could be made of suitable materials—such as graphite and molten copper—it might be possible to extend the useful range of base-metal pyrometers up to or beyond the melting point of platinum, as the boiling-point of copper is 2,310° C. A number of metals were tried, and some curious abrupt changes of E.M.F. were noticed. The matter is still in the experimental stage.

Examinations in Switching.—Mr. H. F. Ware, of Macclesfield, has secured the premier place in the advanced grade of the recent Supplementary Competition in Electric-light Switching. Eight other competitors passed in the advanced grade, 30 in the intermediate grade, and 36 in the preliminary grade. Messrs. Lundberg are to be congratulated in maintaining the interest of their subject in these times. Mr. S. Frankland, of East Morton, Yorks, was first in the intermediate grade, and Mr. M. D. Vinell (Tonbridge) in the preliminary grade.

LOCAL NOTES

Bridlington: *Unsatisfactory Report.*—The Deputy Borough Electrical Engineer acknowledges the unpleasant duty of placing before the Council probably the most unsatisfactory annual report during the existence of the undertaking. The output has decreased by 40 per cent. compared with the last normal year of working, and the plant has been closed down fifteen times during the year in consequence of aircraft alarms, resulting in a loss from this cause alone of some 4,000 units. The result of last year's working is a deficit of £1,321, which, however, owing to the sound financial policy pursued by the Committee in past prosperous years, can be met from reserve.

Brighton: *Electricity Deficit.*—There was a loss of £3,989 on the electricity undertaking last year, which will be taken from the reserve fund. Owing to the lighting restrictions and other causes due to the war, Mr. J. Christie, in his report, states that a comparison between last year and the previous one is of little value; but a comparison between the figures for 1915-16 and those for the year to March 31st, 1914, shows a diminution of sales by nearly 1,500,000 units, but an increase in revenue of £159. The cost of coal has increased by £9,000.

Derby: *Progress of the Electricity Undertaking.*—In moving a recommendation to borrow £9,000 for mains and motors at the last meeting of the Corporation (see Tenders Invited column), the Chairman of the Electricity Committee said there is still a great demand for mains and motors from companies and firms engaged on war work, and £4,000 of the £9,000 in question would be necessary during the next eight or nine months to supply various firms whom it was in the interests of the town to encourage. The balance is necessary for a new company which is expected shortly to erect works in Derby.

London: *L.C.C.: Greenwich Power House.*—In order to burn cheaper qualities of coal in the boilers at the Greenwich power house an experiment is to be carried out by fitting four of the existing boilers with new grates having considerably larger areas than the present grates. It is hoped by this means even to use coke, and the result of the experiment will have a bearing upon the boiler equipment of the four new turbo-generators.

Kensington: Supply Co.'s Assessment.—The Brompton and Kensington Electricity Supply Co. has been successful in getting the gross assessment of £22,000 and the rateable value of £12,000 upon their undertaking in Kensington reduced to £16,778 and £11,375 respectively.

Luton: *New Sub-Station.*—A new sub-station was opened last week to meet the growing demand in the neighbourhood of the Dunstable Road. The total cost has been £13,415.

Manchester: *Rate Relief.*—A proposal is to come before the Corporation that the present basis upon which the municipal trading departments contribute out of profits to relief of rates should be revised, having regard to the present high rate of income tax and the liability of the profits of the undertakings to excess profits tax.

Plymouth: *Satisfactory Electricity Report.*—There was a net profit on the electricity undertaking last year of £2,485, which the Committee has decided to add to reserve.

Stoke-on-Trent: *New Plant.*—We recently mentioned that a proposal to spend £12,000 on new plant had been referred back to the Electricity Committee. The scheme has now been again placed before the Corporation, with a recommendation that the plant is essential.

West Ham: *Deficit of £26,000.*—In reporting the large deficit of £26,000 upon the working of the electricity undertaking last year, Mr. J. W. Beauchamp, Manager of the undertaking, points out that although the net increase in units sold was only 0·7 per cent., there was an increase in expenditure of no less than £24,142, of which fuel is responsible for £16,000. There was a considerable increase in output for power, viz., 1,813,453 units; but this has been offset by further reductions in lighting and traction supplies. Furthermore, the increased charges to the consumer made in November, 1915, have only partially benefited the undertaking during the past year. The turnover of the installation and development department has been reduced by one-third over the past two years, but in spite of this a net surplus of £70 was shown in 1915-16, after bearing all charges, direct and indirect. Publicity and canvassing work has been stopped during the year, mainly through lack of staff, but although there has been some check upon the usual rate of development in private houses owing to the Treasury restrictions as to capital expenditure, the large stock of wiring material and motors has been very useful in this connection. It has been decided by the Corporation to meet this heavy deficit out of the rates, and in a special report the Borough Treasurer calls attention to the need for a revision of prices and to the lack of a reserve and renewals fund.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The Sydney Municipal Council require four 10,000/550-volt transformers. Tenders by August 7th to Town Clerk. As the time is so limited, obviously this intimation will be of use only to firms who can cable agents. The specification may be consulted at 73, Basinghall Street, E.C.

Derby.—Application is to be made for sanction to a loan of £9,000 for mains and motors for war purposes.

Rotherham.—Extensions of plant are contemplated at an estimated cost of £50,000.

Worcester.—Application is to be made for a loan of £14,000 for plant to meet the demands for a new factory to be built for the King's Norton Metal Company.

APPOINTMENTS AND PERSONAL NOTES

Company Sergeant-Major E. C. Laughton, who for nine years was associated with the lamp and fittings department of Siemens Brothers' Dynamo Works, has been killed in action. He joined H.M. forces in September, 1914, and sailed for France early in May, 1915, and had, therefore, over 14 months' active service to his credit. Commencing as an ordinary private, he gained promotion to corporal before leaving for France, the remaining steps having been attained while on foreign service. We have no details regarding the circumstances of his death, official notification of which was made on Monday, the 24th ult., although the records show that he was mortally wounded in the very early stages of the great offensive. He was serving with the 8th East Surrey Regiment, which, according to newspaper reports, suffered heavily in the attack on the Fricourt section of the line. He was intimately known to many members of the electrical industry, who will deplore with the firm the loss of a valued friend and colleague.

We regret to notice in the recent lists of casualties on the Western front that Lieut. J. Challoner, R.E., has died of wounds received on July 25th. Lieut. Challoner, who received the Military Cross a short time ago, was an Associate Member of the Institution of Electrical Engineers, and before the war was with the British Westinghouse Co. at Cardiff.

At a special meeting of the Main Committee of the Engineering Standards Committee (Sir John Wolfe Barry, K.C.B., Chairman), held on July 27th, Mr. Charles le Maistre, who has been in charge of the work of the electrical section since 1903, was appointed Secretary to the Committee, in succession to the late Leslie S. Robertson, who was lost with Lord Kitchener in the disaster to H.M.S. "Hampshire."

Mr. J. S. D. Moffet, General Manager of the West Ham Corporation Tramways, has been appointed General Manager of the Belfast Corporation Tramways, at a salary of £800, rising to £1,000 per annum.

Mr. R. B. Leach, Borough Electrical Engineer and Tramways Manager at Heywood, has been appointed Borough Electrical Engineer at Loughborough in succession to Mr. W. H. Allen, recently resigned.

Lieut. G. Marconi has been promoted to Captain in the Italian Army "for exceptional services."

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £123–£127 (last week £120 to £124).

ELECTRICAL ENGINEERING

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With which is Incorporated

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SUMMARY

The formation of a national statutory Board of Science and Industry is one of a number of suggestions embodied in a memorandum issued by the British Science Guild (p. 302).

Two doctors in Vienna have developed a method of viewing bullets, etc., by X-rays during the actual operation of their extraction (p. 302).

An instrument for measuring high voltages by observation of the first appearance of corona formation has been described by Messrs. Whitehead and Pullen before the American Institute of Electrical Engineers. The corona is produced in a cylinder enclosed in an airtight chamber in which the air pressure can be varied. A wide range of voltage measurement is obtained by variation of the air pressure. The formation of corona is detected either visually, or by means of an electroscope, galvanometer, or telephone. Tests showing the constancy and permanence of the instrument are described (p. 303).

A sub-committee of the Standards Committee of the American Institute of Electrical Engineers has issued a report containing suggestions for a classification and nomenclature for A.C. commutator motors (p. 304).

The problems involved in coupling several continuous current motors to one line of shafting are discussed in Questions and Answers (p. 305).

We publish an abstract of a paper on the economical production of power from coke-oven gas, read by Mr. G. Dearle before the Yorkshire Section of the Institution. The author describes the successful results he has obtained with an installation of three 500-b.h.p. gas engines direct coupled to three-phase alternators (p. 306).

Some notes are given on the equipment of a water-power station in Italy supplying an 88,000-volt transmission line (p. 307).

A scheme has been proposed in Bavaria for the utilisation of extensive low-head water power for purposes including the electrical manufacture of nitrates for explosives (p. 307).

Among the subjects of specifications published at the Patent Office last Thursday were wireless telegraphy and textile machinery drive. Licences have been granted under enemy-owned X-ray patents. Application has been made for the restoration of a lapsed induction motor patent. Four wireless telegraph patents expire this week after a full life of fourteen years (p. 308).

Two railway servants were killed and thirty-six injured through contact with live rails or overhead wires on electric railways in Great Britain during 1915. Of these, however, fourteen, including one fatal accident, occurred on the recently electrified lines of the London & South-Western Railway Co. (p. 308).

New Board of Trade regulations have been issued under Section 4 of the Electric Lighting Act of 1888. The principal alterations refer to earthed conductors (p. 309).

There was a profit of £17,492 at Belfast last year and £2,371 at Marylebone. Deficits of £6,679 and £2,845, however, were shown at Southwark and Dartford respectively. Complete details have been drawn up of a new power station at Blackburn, but the scheme will not be proceeded with at present (p. 309).

A loan of £7,000 is required at Loughborough, and ash-handling plant at Manchester (p. 310).

1st LONDON ENGINEER VOLUNTEERS

Headquarters, Chester House, Eccleston Place.

Orders for August, 1916, by Lt.-Col. C. B. Clay, V.D., Commanding.

Headquarters and Range.—The Headquarters will be closed during August, except on Tuesday evenings. The range will be open on Thursday evenings only. On these evenings the Sergeant-Major will take charge and be responsible for the maintenance of order and discipline. Recruits are urged to take advantage of this arrangement for drill and shooting.

Instruction Classes.—Instruction classes at Regency Street will be held as usual for Platoons Nos. 9 and 10.

Camp.—The Camp at Otford will be available until August 31st. Members wishing to attend should enter their names at Headquarters on the sheet provided for the purpose. The cost will be about 3s. per day. Members should provide themselves with 2 blankets, knife, fork, spoon, plate, mug, and a spare pair of boots.

Entrenching.—As many members as possible should endeavour to attend the Sunday Entrenching Parades, in order that the work to be done may be completed as expeditiously as possible. Parade in Uniform, as usual, at Victoria Station (S.E. & C. Rly.) Booking Office, 8.45 a.m. Members are reminded that this work is of national importance, and, therefore, all who are able to put in Saturdays and occasional week-days are urged to do so. They are reminded that they can obtain railway vouchers from the booking clerk by showing their cap badges.

THE ELECTRIC VEHICLE COMMITTEE

Imports of Commercial Vehicles

At the meeting of the Electric Vehicle Committee held on July 28th it was announced that the Royal Automobile Club has nominated as their representative upon the Committee Mr. W. Worby Beaumont.

Correspondence has taken place between the Board of Trade and the Committee with regard to import restrictions, and this correspondence has been published. The Secretary of the Committee wrote to the Board of Trade on July 7th pointing out the increasing adoption of the electric battery vehicle for commercial purposes, and asking that the import restrictions upon commercial vehicles should be waived in respect of electric battery vehicles owing to the impossibility of obtaining such vehicles of British make. The effect upon the electric supply industry was pointed out, as was the simplicity of control of such vehicles, which enables men of military age to be released for service with the Forces, as women or elderly men can become proficient in driving after but a few hours' tuition. It was pointed out also that there is at the present time but one British firm making the heavy type of commercial electric vehicle now in such demand, and it is understood that they are quite unable to cope with the orders coming to them as they have but recently taken up this line of manufacture, and are heavily involved in the production of munitions of war. It was therefore asked that there should be free importation at the present time of American-built commercial electric vehicle chassis. The Board of Trade replied on July 11th to the effect that if the Committee will send a statutory declaration to the effect that the chassis it was desired to import are to be used solely for commercial purposes, the matter of their importation should have consideration.

Arising out of correspondence that the Secretary has had with the Clerk to the Urban District Council at Rugby in the matter of providing charging facilities for electric vehicles, the Secretary was directed to write and say that the Committee regretted the Council's decision not to provide such facilities at the present time. It should be noted that the British Thomson-Houston Co. are prepared, when their own arrangements admit and at times convenient to themselves, to charge electric vehicles passing through Rugby.

THE STATE AND SCIENCE

Proposals of the British Science Guild

ALTHOUGH the British Science Guild was founded in 1905 with the object of bringing home to all classes "the necessity of applying the methods of science to all branches of human endeavour," it is only since the beginning of the present European crisis that the Guild has found the required opportunity to adequately impress upon those who are engaged in the executive functions of government, as well as upon those who are concerned with industry and commerce, the paramount importance of scientific method and research in national affairs. The Guild, of which the Right Hon. Sir William Mather, P.C., LL.D., is President, has issued a memorandum, signed by many eminent public men in the worlds of science, industry, and education, embracing the definite suggestions of its executive committee. After much discussion of the matter, the Guild has arrived at the conclusions that "the material prosperity of the civilised world during the past century is mainly due to the application of science to practical ends," that the State has neglected to encourage and facilitate such application, and that the present control of all stages of educational work, from the Primary School to the University, mostly by men who have an inadequate appreciation of the meaning and power of science, is largely responsible for the "unsatisfactory preparation commonly provided for the work of life."

Since its foundation the British Science Guild has urged that serious attention should be given to these defects, and its memorandum now issued include the following seven definite recommendations:—

I. A national statutory Board of Science and Industry, the permanent staff of which should consist mainly of persons of wide scientific knowledge and business experience, should be established to:—

(1) Promote the co-ordination of industrial effort. (2) Secure co-operation between manufacturers and all available laboratories of research. (3) Co-ordinate, and be the executive-centre, of such joint scientific committees as have been formed by the Royal Society, the Chemical Society, and various trade and educational associations. (4) Undertake inquiries as to products and materials, and generally to serve as a national bureau of scientific and industrial intelligence. (5) Collect and publish information of a scientific and technical character; and provide so far as possible for the solution of important problems bearing upon industry. (6) Institute a number of paid advisory committees consisting of men of wide scientific knowledge assisted by expert investigators and technologists who should receive reasonable fees for their services. (7) Organise scientific effort on the manufacturing side and in commercial relations with other countries. (8) Arrange measures for the mobilisation of the scientific, industrial, and educational activities of the nation so as to ensure ready response to national needs and emergencies. (9) Encourage investigation and where necessary give financial aid towards the synthesis and artificial production of natural products and for other researches.

Such a Board would naturally administer the scheme of the Privy Council Committee, as well as take over certain functions of existing Departments and Boards. The functions of the Board would be much the same as regards the promotion of scientific and industrial research and training, the co-operation of universities with industries through trade associations, and the maintenance of a record of scientific and technical experts, as outlined in the report on "British Trade after the War" by a Sub-Committee of the Board of Trade.

II. In all Departments of State in which scientific work is carried on adequate provision should be made for the periodical publication and wide distribution of bulletins, leaflets, and reports, so that increased public interest and attention may be encouraged in the results.

III. Every industrial undertaking subsidised or otherwise assisted by the State should have upon its board of directors men who possess expert scientific knowledge of the business in which they are engaged.

IV. In order to develop industries which especially require the services of scientific workers, adequate remuneration and improved prospects should be offered by the Government, by municipal corporations, and by manufacturers, to men who have received an effective scientific training. Means should be found of compensating and rewarding persons whose researches have proved of decided national or public advantage without being profitable to themselves.

V. A knowledge of science should be regarded as an essential qualification for future appointments in the departments of the Public Service concerned with industrial, scientific, and technical developments. The Royal Commission on the Civil Service recommended in 1914 that a committee should be appointed to consider the present syllabus of subjects of examination for Clerkships. (Class I.) This committee should be constituted without delay, and science as well as other branches of modern learning should be adequately represented upon it, and upon the Civil Service Commission itself.

VI. Measures should be taken to revise the educational courses now followed in the Public Schools and the Universities of Oxford and Cambridge.

VII. In elementary and secondary schools supervised by the Board of Education more attention should be given to scientific method, observation, and experiment, and to educational handwork.

SURGERY UNDER X-RAYS IN AUSTRIA

AN interesting development in X-ray working was recently described before the Society of Surgeons in Vienna by Drs. Holzknecht and von Eiselsberg, who have successfully performed a large number of operations on wounded soldiers with simultaneous direct and X-ray vision of the bullet or other object to be extracted. This, they claim, renders the extraction much quicker and easier, with less cutting and probing, and less risk of the wound becoming septic. In his earlier experiments Holzknecht had watched, with the aid of a small screen, the extraction of a needle from a hand, the X-ray apparatus being arranged so as not to interfere with the surgeon's work. In this case, when the hand was placed on the operating table, he could see that it must have been placed in a different position from that in which it was radiographed, and the locality of the needle marked externally, so that the needle did not come under the external mark. Consequently the incision was made in the wrong place. The clips holding the wound open drew the needle further out of place, and the contraction of the tissues below also helped to alter its position. As a result it was some considerable time before the needle was found by the operator, in spite of the previous application of X-rays and the comparative simplicity of the operation. Convinced of the importance of simultaneous X-ray vision during operation, he then elaborated a method to enable the operator to see an X-ray image of the object searched for, thus guiding his instruments to their goal.

Details were given of over thirty operations performed in this way. Very scanty details of the apparatus itself have been published, but it appears that the operating surgeon wears a special kind of headgear, which supports in front of one eye a miniature fluorescent screen, or "Grasley Monocle," suitably enclosed with a felt hood, so that he sees the actual wound with one eye and an X-ray view with the other.

At the hospital in Vienna where the apparatus is in use the X-ray apparatus is arranged in a room below the operating-room, and a speaking-tube is provided, so that the surgeon can give instructions as to the adjustment of the X-ray tube below the operating table. Reference was also made to a double spectacle-screen (Brillen-Kryptoskop), enabling two X-ray views to be seen, one with each eye, and it would appear that this gives a stereoscopic effect, as it is stated that the depth of the bullet below the probing instrument can be seen and estimated directly with the aid of this screen. Reference was made also to the use of "localising pointers" invented by Dr. Gottwald Schwarz. These are set by the operator (when viewing under the X-rays) to point to the bullet, and they thus afterwards indicate the exact position and depth of the bullet when ordinary light only is in use.

ELECTRIC TRACTION NOTES

The Council of the Municipal Tramways Association has fixed September 21 and 22 for the Annual Convention this year. It will be held in London.

A sub-committee of the Middlesbrough Corporation has been appointed to consider the question of taking over the undertaking in the Town of the Middlesbrough, Stockton and Thornaby Electric Tramways Company. The Company's powers expire in 1918, and six months' notice of intention to purchase has to be given. The object apparently of appointing the Committee is the possibility that conditions now will be more favourable for purchase than in 1918, having regard to the manner in which the cost of the various commodities for the operation of such undertakings is now rising.

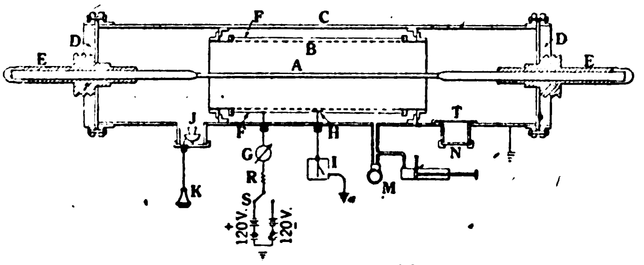
Trial trips have taken place on the electrified London and North-Western Railway line between Broad Street and Richmond. It is anticipated that the regular service of electric trains will come into operation on October 1.

MEASUREMENT OF HIGH VOLTAGES BY CORONA

In a paper read at the recent annual meeting of the American Institute of Electrical Engineers, Messrs. J. B. Whitehead and M. W. Pullen described an instrument for measuring high voltages by observation of the first appearance of corona. The corona as a means of measurement possesses the great advantage that it obeys a definite law upon which close agreement now obtains among many observers. If it is possible to foretell with a good degree of precision the value of voltage at which corona will begin on a clean round conductor an absolute calibration is also possible. From the nature of the corona it will be evident that an instrument using it as an indicator of voltage can make no pretence to a direct-reading scale. No more can the needle gap or the sphere gap. The corona voltmeter as described, however, possesses, among other advantages, two important features, which, in the absence of a direct-reading scale, are very good substitutes. (1) Convenience of observation. (2) A wide range of voltage without manipulation or adjustment of the instrument.

The appearance of corona obeys a rigid law only when the wire or rod on which it appears is accurately placed on the axis of a hollow cylinder forming the opposite side of the circuit. This arrangement has therefore been chosen for the voltmeter. In the present form the outer cylinder is grounded, thus presenting the advantage of screening the wire from outside influence and permitting close approach to it without danger. Three methods of observing the beginning of corona, not including visual observation, have been developed; the electroscope, the galvanometer, and the telephone.

At atmospheric pressure and temperature, a given diameter of wire or rod, placed in a given outer tube, will form corona at one and only one definite value of voltage. Hence to obtain any range in an instrument using corona under atmospheric conditions would require a change in the diameter of the outer cylinder or of the inner conductor, or in the use of a wire or rod of varying diameter. A change from one conductor to another is not impossible, but is manifestly troublesome and objectionable, save, perhaps, under laboratory conditions. The use of a conductor of varying diameter is not feasible on account of the small temperature variations due to the presence of corona and on account of the necessity of visual observation.



Construction of Corona Voltmeter.

Corona-forming voltage depends on the pressure and temperature of the air. The values of the voltage at which corona forms on a given wire under any conditions of temperature and pressure are now well known. The density of the gas is the determining factor, and variations of density cause quite wide differences in the value of the corona-forming voltage.

The figure above is a descriptive drawing showing the various parts. In order that certain features may be emphasised, no attempt has been made to make the drawing to a uniform scale. The central conductor on which corona is formed, shown at *A*, consists of about 40 in. (101·5 cm.) of Stubb's tool steel, 0·635 cm. in dimaeter. At either end, just outside the cylinder *B*, the central conductor is suitably joined to rods of larger diameter, which extend through the porcelain bushing *E* at either end. The object of this enlargement is to make certain that the electric discharge occurs only within the region inside cylinder *B*. This outer cylinder *B* is 92 cm. long, 30·7 cm. in diameter, is perforated over its entire surface with holes 1·58 cm. in diameter, and is electrically connected to the outer shell *C*, which is in turn connected to earth. The insulators *E* are cemented to the glass discs *D*, which in turn are held between soft rubber gaskets and the flanges on the outer tube. The final centring of the central conductor is accomplished at the ends of the insulators, the central openings of which provide free play for this purpose. *F* is a thin metal cylinder surrounding, and very close to, the perforated cylinder *B*. It is insulated, and connects through a sulphur bushing with the galvanometer *G* and a source of continuous potential *S*. *H* is a small electrode fitting in a hole in *F*, but not touching it, and connected through a sulphur bushing with an electroscope, *I*, whose case is connected to earth. *J* is a telephone transmitter fitting into a side tube. *L* is an ordinary hand air pump for either pressure or vacuum; together with the gauge *M* it is connected to the main containing cylinder. *N* is a small side tube with glass top through which the thermometer *T*, recording temperature inside the tube, may be observed. All permanent joints were sealed with a cement made from litharge and glycerine, while those holding the glass and cap nuts on the end of the central conductor consisted of soft rubber gaskets. No particular care was given to the elimination of unnecessary joints, and it has been found possible to maintain pressure as high as 60 cm. above atmosphere over periods quite sufficient to ensure constancy of observation.

In designing the instrument as described liberal allowances were made in all dimensions. It was the first instrument in which pressure was applied, and in order to provide also for thorough inspection and access to all parts it was realised that it would probably be found unnecessarily large. This proved to be the case. The indications of the appearance of corona by the several methods already described were so satisfactory that it was soon found that the instrument could be made smaller without sacrifice of reliability.

The only limitation which has been found in this first type of instrument is in the insulation. If too large a central conductor is used, say above 1·75 cm. diameter, the high voltage required to start corona causes a spark between the conductor and the outer casing at the edge of the insulator bushing due to a region of high electric intensity. This trouble is entirely eliminated by the use of a smaller corona conductor, with ends of larger diameter, as already described. Corona then appears at lower voltages at atmospheric pressure, and the spark-over voltages at the bushing are never reached. The voltage at that point only rises when pressure is on the tube and sparking is then suppressed.

The pressure in this tube has only been carried to 62 cm. of mercury. This means a total thrust of 2,100 lb. (952·5 kg.) on each end of the plate glass disks at the end. While the central conductor can probably be relied on to take up a part of this thrust the pressure has not been carried higher up to this time for fear of breaking the glass disks. It is not necessary to have the whole end of the tube of glass, as small openings only are required for observing visually the appearance of corona. Therefore, in a tube of the general dimensions given, it should be quite easy to reach pressures far in excess of that mentioned. Our experience indicates that the chief limitation of the instrument is the insulation of the bushing leading the voltage to the central corona-forming conductor.

As a result of the experiments with the foregoing instrument, another was designed for 50,000 volts in which effort was made to reduce the dimensions without impairing its reliability. In all respects the details of the instrument are the same as those already described in connection with the larger type, except that in this smaller type the telephone has been omitted. This was done largely because of the difficulty and time required for setting into the outer cylinder a branch tube large enough to hold the telephone transmitter, the diameter of the main cylinder being only 12·7 cm. Observations are in no wise dependent on the use of the telephone, and this was not considered as a necessary feature for an experimental type of instrument.

The principal dimensions for the smaller instrument are as follows: Outer tube, 12 cm. inside diameter, 24 cm. diameter over end flanges, length over flanges, 52 cm., length over all, 76 cm. The inside or corona tube is 9·51 cm. inside diameter and 29 cm. long. Central conductors or rods of various diameters have been used. In the experiments described the rod was of tool steel, 0·396 cm. in diameter.

In this instrument as in the other the limit has been found in the insulation of the end bushings. In the form shown, brush discharge begins at 65,000 volts over the inside surface of the glass ends. As the insulators were home-made, by making the whole instrument somewhat longer, and improving the insulation, there seems to be no reason why this instrument could not be used for even higher values. The pressure required to reach above 50,000 volts was only 66 cm. of mercury above atmosphere.

Pressure is adjusted and varied in the tubes without trouble by means of an ordinary hand pump, for both vacuum and pressure, about 46 cm. long, and of the type used for bicycle and automobile tires. A valve with small opening permits easy adjustment of pressure.

The general method of taking observations was, with secondary connected to the central conductor of the voltmeter, to raise the voltage gradually, observing the electroscope and galvanometer, and listening with the telephones, singly or all together. Simultaneous readings of all three were possible by using a reflecting galvanometer, and throwing, with suitable mirror arrangements, the image of the electroscope leaf into the telescope used for reading the galvanometer. As soon as any

one or all of the instruments indicated the appearance of corona the voltage was read by an electro-dynamometer type of voltmeter on the terminals of the tertiary coil of the transformer. A large number of oscillograms were taken during the course of the experiments which, with the voltmeter readings, serve to give the crest factors of the voltages in the tertiary coil.

The instrument is susceptible of usage in two ways. (1) It may be set for a given voltage and the applied voltage gradually raised until the desired value is reached, as indicated by the instrument, or (2) with an unknown voltage applied to the terminals, the pressure in the tube may be gradually lowered until corona appears.

The first of these methods would be that commonly used in the testing of insulation. In applying this method the necessary operations are as follows: Read the temperature in the corona tube, take from a table or curve, calculated from the dimensions of the instrument, the value of pressure which, with the observed temperature, corresponds to the voltage required. Adjust the pressure to this value by means of a hand pressure and vacuum pump. Gradually raise the voltage from some lower value until the presence of corona is indicated by one of the methods already described.

In the second method mentioned, in which it is desired to measure the value of an unknown voltage, it is only necessary to run the pressure in the tube up to a value corresponding to a voltage known to be above that to be measured. The pressure may then be lowered rapidly by allowing the air to escape until corona appears. Having approximated the voltage by this means the pressure may be raised again above the value at which corona appears and then lowered as gradually as desirable in order to establish any particular degree of accuracy of observation.

CLASSIFICATION OF A.C. COMMUTATOR MOTORS

THERE has been a great deal of discussion recently in the United States on the classification of a.c. commutator motors, and the Standards Committee of the American Institute of Electrical Engineers has investigated the matter through a sub-committee, which now issues its report, and a list of "suggested definitions of terms used in describing alternating current commutator motors." It is admitted that this list cannot meet with universal approval, but it is believed it will be "subject to the minimum of disapproval." These definitions, it is stated, are to be looked upon as suggestions only, and are not to be considered as adopted by the Institute.

An examination of the list, which we give below, will make it obvious that one cannot hope to fix a nomenclature for a.c. commutator motors which will serve for everyday use, corresponding to the terms by which other types of motors are familiarly described, such as "d.c. shunt motors" or "induction motors." It is probable that each type of motor, as it is developed and becomes commercially useful, will be commonly known by the name of its inventor or of the firm who first develop it. For instance, the motor known as the Schrage motor will probably continue to be known familiarly by that name, in spite of any standard nomenclature, and one will hardly expect to find it in makers' lists under such a heading as "transformer-conduction, compensated, constant field, rotor excited, multi-speed, polyphase motors." However, such a classification would undoubtedly be useful for purposes of technical discussion and study. The sub-committee's report is as follows:—

SUGGESTED DEFINITIONS OF TERMS USED IN DESCRIBING ALTERNATING-CURRENT COMMUTATOR MOTORS.

In no case is it intended that the use of any one term will exclude, or render unnecessary, the use of all the other terms. Each term is intended to refer to a certain group of alternating-current commutator motors; any chosen motor may logically be classified under a large number of different, but non-conflicting groups. Each new term here presented relates exclusively to motors with commutators. Where ambiguity is liable to exist the word "commutator" should be used with the term.

CLASSIFICATION BY PHASES OF ENERGY SUPPLY.

A Single-Phase Motor is one that receives the whole of its energy from only one phase of an alternating-current supply system.

A Polyphase Motor is one that receives its energy from a plurality of phases of an alternating-current supply system.

CLASSIFICATION BY SPEED CHARACTERISTICS.

For convenience, alternating-current commutator motors can be classified with reference to their speed characteristics as (1) constant-speed motors, (2) multi-speed motors, (3) adjustable-speed motors, and (4) varying-speed motors. Definitions of these terms as given for motors in general should be adopted for alternating-current commutator motors, in so far as they are applicable.

CLASSIFICATION BY EXCITATION.

A Stator-Excited Motor is one in which the torque-producing field is due to current in a winding located on the stator.

A Rotor-Excited Motor is one in which the torque-producing field is due to current in a winding located on the rotor—generally the armature.

A Stator- and Rotor-Excited Motor is one in which the torque-producing field is due to current in windings located on the stator and on the rotor.

A Constant-Field Motor is one in which the torque-producing field remains practically constant independent of the load. Alternating-current commutator motors of this class will in general have load-speed characteristics similar to those of the direct-current shunt motor, but not all alternating-current motors having such load-speed characteristics are constant-field machines.

A Varying-Field Motor is one in which the torque-producing field varies in some proportion with the current in the armature—generally the rotor. Such a motor will in general have load-speed characteristics similar to those of the direct-current series motor.

NEUTRALISATION, COMPENSATION AND COMMUTATION.

A Neutralised Motor is one in which use is made of a winding for producing a magnetomotive force opposed in space and in time to the armature reactive m.m.f., over practically the entire pole face.

A Compensated Motor is one in which means, other than a neutralising winding, are provided, for improving the power-factor.

A Commutating-Field Motor is one in which a special field is introduced for improving the commutation.

CLASSIFICATION BY ENERGY RECEPTION.

A Conduction Motor is one in which the working energy is supplied to only one of the members, and is conveyed to it by conduction.

A Transformer Motor is one in which the working energy is transmitted from one member to the other by transformer action. A motor in which the energy required by its armature—generally the rotor—is conveyed to it by electomagnetic induction or transformer action, can properly be referred to either as an "induction motor" or as a "transformer motor." Although it is equally applicable to a motor having a commutator, the term "induction motor" is usually applied to a motor without a commutator. The term "transformer motor" is therefore recommended for use with motors of the induction, or transformer type, having commutators.

A Transformer-Conduction Motor is one in which the energy required by its armature—generally the rotor—is conveyed to it by both conduction and electromagnetic induction.

A Repulsion Motor is a transformer motor in which use is made of independent brushes for short-circuiting a number of coils of the commuted winding.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"Lektrik Schémas de Lumière," avec une Introduction et des Notes, par W. P. Maycock. Adapté de l'Anglais par R. Drilhon. 148 pp. 4¾ in. by 3¼ in. 180 figures. (London: A. P. Lundberg & Sons.) 1s. net; by post, 1s. 1d.

"The Pictorial Russian Course." By S. J. Luboff. 141 pp. 7¼ in. by 4¾ in. 30 figures. (London: L. B. Hill.) 2s. net.; by post, 2s. 2d.

"The Electrical Contractor." By L. W. Moxey, Jr. 86 pp. 9¼ in. by 6 in. 15 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 6s. 3d. net.

"Arithmetic for Engineers." By C. B. Clapham. 436 pp. 8¾ in. by 5¼ in. 149 figures. (London: Chapman & Hall, Ltd.) 5s. 6d. net; abroad, 6s.

L.C.C. School of Engineering.—A special course of twelve lectures on the care, control, and operation of dynamos, motors, lamps, and mains for switchboard and motor attendants, wiremen and others who have charge of electrical plant will be given at the London County Council School of Engineering and Navigation, High Street, Poplar, E., on Friday evenings commencing September 22nd. It is expected that each lecture, which will be followed by practical work in the electrical engineering laboratories and wiring shop, will last from 7 to 9.15 p.m. At the conclusion of the course an examination will be held.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,506.

I have just had to take charge of a battery of 58 cells used for lighting purposes, and find that although the battery is still being used, the majority of the positive plates have broken and dropped to the bottom. I know that the battery was in excellent condition eighteen months ago, after four years of service. What is likely to be the cause of such sudden and rapid deterioration? Are the negative plates liable to be damaged by using the battery in its present condition during an emergency period? What proportion will the cost of new positive plates bear to the original cost of the cells?

R. R.

(Replies must be received by first post Thursday, Aug. 17th.)

ANSWERS TO No. 1,504.

Three 50 h.p. shunt motors are driving separate lines of shafting, and it is proposed to couple these lines into one shaft and to fit an additional (stock) 40 h.p. shunt motor to cope with an increased load. As belt-drives are employed, will the motors take their proper share of the varying loads without constant adjustments to their field regulators, or could this be ensured by any means of compounding the motors?

(2) Are the conditions altered in either case by fitting interpoles?

(3) Would the motors divide their loads in the correct proportion if a positive drive were employed, *i.e.*, gear or chain instead of belts, whether or not shunt or compound windings were employed?—PUZZLED.

The first award (10s.) is made to "Y. Z." for the following reply:—

When several motors are working in parallel on a common load, they are bound to each other electrically and mechanically, and the way in which each individual machine does its share of the combined output depends on how it is affected by the two sets of conditions working in combination. The fact that all the motors are mechanically coupled to a driven load which obviously must have the same speed at all parts of it, means that apart from possible belt-slip the relative speeds of the motors are always the same, *i.e.*, if the speed of the shafting drops 10 per cent. for any reason, the speed of every motor drops 10 per cent. at the same time, and so on. Now suppose that the sizes of pulleys on the various motors are so chosen that at light load on each machine they run at the same peripheral speed, then clearly the various motors are correctly related to each other at that particular load, when belted to a common shafting. When load is put on the shafting, the speed will drop, and the amount of load taken by each motor will depend upon its electrical conditions. Suppose, for example, that such a load is put on as makes the whole arrangement run 5 per cent. slower, this drop being determined by the motors adjusting themselves until they are, as a whole, just balancing the external torque of the loaded shaft. Now remember that there is a definite relation between the drop in speed of a shunt-wound motor and the current which its armature takes, for the reduced speed corresponds to a certain reduction in back electromotive force, and therefore to an increase in armature current. Some motors drop 2 per cent. between no-load and full-load, say; others may drop 10 per cent., according to their design. If the general combination of motors is such that the combined drop of speed is 5 per cent., then a motor with a speed drop of 5 per cent. from no-load to full-load will just do full load; one with a drop greater than 5 per cent. will do less than full load; and one with a less drop will be overloaded. In order, therefore, to make quite certain that each motor takes its proper share of the load, the machines used must be such that, for a given change in load, the speed of each changes by the same proportionate amount. If every motor drops 5 per cent. from no-load to full-load, then, in the above case, each motor would just be fully loaded; while if each motor drops 10 per cent. from no-load to full-load, then, if the speed-load curve is reasonably straight, each machine would be about half loaded in the assumed case; and so on, similarly. That is, the speed-load characteristics of all the machines must be as nearly as possible the same, if the load is to be correctly divided.

Bearing the above general principles in mind, the question may be easily answered. Presumably the three 50 h.p. motors are alike in design, and therefore, if the brushes are similarly set on them all their characteristics should be identical, and there will be no trouble with them. If the 40 h.p. motor can be adjusted to have about the same characteristic as the 50 h.p. machines, it will run quite successfully. Even if its curve has not quite the same shape throughout, but can be made to have the same drop between no-load and full-load, that is enough, as all the motors will be fully loaded together, although at less than full-load they may not divide the load in exactly the correct proportion. If the 40 h.p. motor has a curve radically different from that of the 50 h.p. size, then the load will not be taken proportionately. The suggestion of compound winding may sometimes be usefully adopted in such a case, provided enough compound winding can be got on to have a marked effect on the flux of the motor, that is, provided the field is not already saturated by the shunt winding. For by adding compound winding, the speed-load characteristic may have its droop increased, and in that way, by compounding in various degrees the motors which are to run together, proper division of load will be secured. The motor with the biggest drop as a shunt machine would be left unaltered, and the others would be made like it. When motors are worked with rather weak fields, it is sometimes advisable to compound them, even if they are duplicates of each other. For such motors are rather sensitive, as regards their speed-load curve, to slight changes in brush position or bedding, and so may get upset; or their belts may not be equally tight; or for some other cause one may tend to take more load than the other. If compound wound for a fairly heavily drooping characteristic, the overloaded motor will increase its flux rapidly, and will actually produce its share of the torque with less current (owing to the increased flux) than would otherwise be the case. For motors of this design, therefore, compound winding may not actually equalise the loads as outputs, but it enables the motors to give their different outputs with less departure from the correct input in amperes than might otherwise be the case. Each case is decided on its merits, but clearly compound winding may be used frequently with advantage. Well saturated shunt-wound fields cannot, however, be much influenced by it.

Considering now the question of interpoles, it should be remembered that the addition of these makes motors generally much more sensitive, as regards the shape of their speed-load characteristic, to changes in brush position or bedding than is the case with motors without interpoles, especially if the interpole motor has a weak main field. This very fact makes it often easy, by small changes in brush position, to adjust various sizes of motors to have the same characteristic, but it must always be remembered that the adjustment is correspondingly easily upset. Hence it would appear wise to use a compound winding, giving a drooping characteristic when interpoles are used, as a motor with such properties is always more stable than one with a level or rising characteristic. With these precautions in view, interpoles may be added practically without altering the conditions, and, if adjustment by their means is not carried too far, may even be used to improve the division of load by brush adjustment, provided this is possible without getting out of the good commutating zone.

As regards the difference between flexible drive by belt and rigid drive by gear or chain, the flexible drive is usually better if the characteristics of the motors are likely to be different. For if one machine should become severely overloaded, it would be relieved by its belt slipping, which would cause the load to be transferred to other motors. But if the drive be rigid, such adjustment between the machines becomes quite impossible, and therefore much greater overloading of individual machines might occur with a gear drive than with a belt drive. If all the motors have identical characteristics, the sort of drive does not matter; if they have not, it is preferable to use compound-wound motors and belt drives.

The second award (5s.) is given to "Koil" for the following:—

To safeguard a 40 b.h.p. motor against taking more than its correct proportion of load when driving a shaft with other motors it is necessary to see that the speed-load characteristic is the same for all. For example, if a 50 b.h.p. and a 40 b.h.p.

motor are together driving a shaft, they should be so adjusted that they run at the same speeds when loaded in the ratio of 50:40 throughout the whole range of load.

A simple way to check this is to connect an ammeter in each motor circuit, set the regulators to give the same speeds at no load, and observe the difference in load distribution under working conditions. If any motor is taking more than its share of load it is a sign that it is tending to run too fast. The inequality may be corrected by moving the brushes of this machine forward, thus decreasing the demagnetisation effects of the armature ampere turns, and incidentally increasing the speed drop as the load is increased, or, the adjustment may be made by moving the brushes of the other motors backward, thus giving the reverse action to the above.

In closely designed, fully loaded, non-interpole machines neither of the above remedies may be practicable owing to sparking considerations, and it is thus seen that interpoles may prove of considerable advantage in view of the wider sphere of satisfactory commutation they provide.

Belt driving is rather more favourable to equal distribution of load over the various motors than either direct, gear, or chain drive, as the increased tendency of the belts to slip with increasing load acts, to some extent, as a regulator.

It is desirable that the inherent speed variation of motors on this duty be as small as possible in order that the shaft may run at practically a constant speed, regardless of the number of machine tools in operation. Consequently the adoption of compound-wound motors—with any appreciable amount of series winding—is not to be recommended. The "compounding" obtained by movement of the brushes should prove ample. It may here be pointed out that the speed should, in all cases, *slightly* drop as the load is applied, as this gives an additional safeguard against any one motor being excessively loaded.

It is not usually desirable to group too many machine tools on one shaft, owing to the waste consequent on running long lines of shaft when only a few tools are required, and to the slight complication introduced by the necessity of having all motor characteristics similar. If, however, other local advantages outweigh the former of these points no real difficulty should be obtained by the latter provided the precautions outlined above be taken.

PRODUCTION OF POWER FROM COKE-OVEN GAS

A PAPER by Mr. G. Dearle, on the economical production of power from coke-oven gas, was read before the Yorkshire Section of the Institution of Electrical Engineers in May, and it appears in the current issue of the Institution *Journal*. The author deals with the production of power in collieries, where a proportion of the output of coal is converted into coke in either waste-heat or regenerative ovens, there is in this case always a certain surplus volume of gas of high calorific value which is available for the production of power. The advantage of regenerative ovens is that the whole of the surplus heat in the coal is produced in the form of a combustible gas instead of merely as a waste-heat product. This combustible gas can be used to much greater advantage than the waste-heat product, for by utilising it in gas engines it is possible to develop 3 to 4 times the power that can be obtained from the use of waste heat under boilers. In the course of the past three years the author has had frequent occasion to wonder why the large gas engine has not been more widely adopted as the prime mover at collieries and other installations where waste gas is available. A great deal of prejudice exists amongst a certain class of engineers against the use of gas engines for large power work. With the exception of perhaps those few who have had the unfortunate experience inseparable from the development of a type of prime mover which, after all, has only been produced in a commercially operative form for large power purposes during the past fifteen years, the author is satisfied that such prejudice is born primarily of lack of experience of what can be done with a gas engine designed on modern lines.

The principal objections raised by opponents of gas-driven power plant are:—(1) The unsteady turning moment. (2) The difficulty of starting the engine. (3) The general absence of reliability in operation. (4) High cost of maintenance.

In this paper the author endeavours to show from his personal experience with a modern gas-driven electric station operating under conditions which may fairly be described as severe for any type of power plant, that such objections are without foundation in the case of an installation put down on sound engineering lines.

The installation under review consists of three 500-b.h.p. vertical tandem gas engines direct-coupled to 3-phase alternators, generating current at a pressure of 440 volts and a frequency of 50 cycles per second. The gas engines are of the single-acting type operating on the Otto or 4-cycle principle, the cylinders being so arranged in tandem that the suction stroke of one cylinder is the explosion or working stroke of the other cylinders on the same line. By this arrangement each crank receives one impulse per revolution, each down-stroke being a working impulse of either the upper or the lower cylinder. On the up-stroke the inertia of the moving parts is absorbed by the compression of either the top or the botton cylinder, and part of the inertia is absorbed on the downward stroke by a buffer cylinder formed under the upper piston. By means of this arrangement the connecting rod is always in compression and little or no strain is thrown upon the connecting-rod bolts.

There are eight cylinders on each engine, the four upper ones having a diameter of 16½ in. and the lower ones 15½ in., with a stroke of 16 in. The speed of the engine is 300 r.p.m., and the full load is 500 b.h.p. The object of making the upper cylinders 1 in. larger than the lower ones is so that the whole line of pistons may be removed together. By this arrangement the dismantling of the engine for cleaning purposes becomes very simple, and if the engine is urgently needed this work can be carried out in 3 to 4 hours.

The engine is started by means of compressed air, which is stored at a pressure of 300 lb. per square inch in a series of six storage tanks mounted outside the power-house. Each of these tanks when fully charged is capable of giving five starts. The air is compressed by means of 2-stage compressors, and these are arranged in duplicate, one being driven by a motor, and the second by a small gas engine drawing its supply of gas from the same main which feeds the larger engines.

The gas supply is obtained from a battery of 110 Otto ovens; 60 of these are waste-heat and 50 are of the regenerative type. From the former about 15 per cent. of the total gas is available, and from the latter about 40 per cent.

After all the by-products are removed, that is after the gas has passed the benzole scrubbers, the gas is drawn to the engines by means of a steam-driven exhauster of 60,000 cubic ft. per hour capacity. This exhauster is governed by a diaphragm governor controlled by the pressure of the gas in the main at the engine stop-valves. An electrically-driven exhauster is installed as a stand-by, and this is controlled from the power-house switchboard and is capable of dealing with 30,000 cubic ft. per hour. The exhauster is driven from a 10-h.p. motor by means of a silent chain-drive. A further steam-driven exhauster is, however, to be installed, as the electric exhauster is found to be scarcely large enough for the work during peak loads.

The further purification of the gas after it leaves the by-product plant is a most important item, and it is surprising that the question of gas purification should be treated by prospective purchasers of gas-power plant—and even by some makers—with such scant consideration. When steam-driven plant is installed no hesitation is shown in providing for water softeners, economisers, and the lagging of steam mains, yet when a gas-engine-driven plant is considered, the purifier appears to be looked upon as almost a luxury, and in this very reason we may find some of the failures of gas-driven plant.

The current from the generators is delivered to a 13-panel switchboard, consisting of one voltage-regulating panel, three generator panels, one summarising panel, and seven outgoing feeder panels. A testing panel is also included in the power-house equipment, and suitable means for testing motors up to full load is provided by means of a "Walker" air-brake dynamometer. The motors connected to the mains aggregate approximately 1,700 h.p. and operate the whole of the coke-oven machinery, the fans, haulages, belts, shakers, fitting shops, saw-mills, &c. The lighting load connected averages about 70 kw. The daily load on the station reaches peaks of 1,050 kw., and the average load during the 24 hours would approximate 580 kw. The station is running continuously, seven days per week.

After thus dealing with the type of plant and its conditions of working, the author deals with some of the results obtained and the methods employed in the running of the plant. During the initial running of the plant some trouble was experienced due to the difficulty of obtaining satisfactory mixing of the very rich gas and air. The result of the poor mixing was a certain amount of overheating, but this trouble was soon entirely overcome. A usual method of dealing with this has been to dilute the mixture with a certain amount of exhaust gas. This method has always appeared to the author to be somewhat inefficient and was not resorted to. The main gas-pipe to each engine was reduced for a distance of about 10 ft. to an internal diameter of 2½ in., and on reaching the engine was led into the mixing chamber for a distance of about 6 in. Entering the mixing chamber at right-angles to this pipe, and about 3 in. above its end, was an auxiliary air supply, controlled by a diaphragm governor. The gas admitted to the mixing chamber was then diluted here by a certain quantity of air. A further air supply, controlled by a hand-lever from the driving platform, was led direct into the chamber of the governor valve, where the diluted gas and air met. After passing through the chamber of the governor valve, the mixture was given a rotatory motion by means of a set of vanes, and was also very thoroughly mixed by being passed through a set of perforated plates. With this device no overheating or pre-ignition is noticed, and the engines can be run up to and above their rated capacity without trouble.

The wearing quality of the engines is particularly good, and the repairs needed have been very small. The total cost of repairs, including wages and spare parts used, for 12 months is 0·037d. per unit generated, which cannot be called excessive. The most tried part of a gas engine of the type under discussion is the exhaust valve, and the material which has been found to be the best for the work is nickel steel.

With regard to the four points raised in the early portion of

the paper, the first point regarding the uneven turning moment has been disposed of. Turning to the second point raised, viz., the difficulty of starting a gas engine, the following is the author's experience. As previously mentioned, duplicate ignition systems are fitted to allow for easy starting, but not once in a hundred times is the accumulator used for starting. The engines can be got away on the magneto, from cold, in 8 seconds. This has been done many times, and with a good man on the switchboard a machine can be paralleled in 25 seconds. This assumes that two men are available for the operation. With only one man to do the running-up and paralleling, one minute would very easily suffice. With such results it surely cannot be said that the modern gas engine is difficult to start.

The third point mentioned was unreliability. The plant now described has no stand-by for 10½ hours out of the 24, and during that 10½ hours is run up to, or very little below, its full capacity. These conditions have prevailed for the past 12 months without one involuntary stop.

Finally, as to the cost of maintenance; during the 12 months ended June 30th, 1915, 3,378,440 units were generated at an average cost of 0·132d. per unit. The capital cost of the plant was £12,247, and it had been in operation two years at the commencement of July, 1914. The costs include all charges except interest on capital, depreciation, and gas used. The items are as follows :—Management (portion allocated to power-house), 0·009d.; drivers' wages, 0·031d.; cleaners' wages, 0·023d.; oil, water, waste, &c., 0·022d.; sundry stores, 0·002d.; repairs, including labour, 0·037d.; purifiers, including labour and oxide, 0·008d.; total, 0·132d.

The power-house staff consists of 9 men: a foreman driver, four drivers, and four cleaners. The shifts are of 8 hours' duration.

A vital question in the running of this type of plant is lubrication. The temperature of the cylinder walls of a gas engine has a great bearing on the viscosity and destruction point of the oil used, and more especially is this true of an engne operating on coke-oven gas. As far as possible the lightest oil should be selected, since it must be accepted as a fact that the lighter the oil the less the carbon deposit will be. Also, a thin oil absorbs a minimum amount of power.

AN ITALIAN 88,000 VOLT TRANSMISSION

OUR French contemporary, *La Lumière Electrique*, publishes a description of the 88,000-volt transmission system by which power is supplied from the works of the Italian Electrochemical Co. on the River Pescara to Naples, a distance of 385 kilometres. The water-power generating station itself and the switch and transformer house are in separate buildings, connected by a railway with a 13 per cent. gradient, up which trucks containing parts of the mechanism, &c., were hauled during erection by an electric capstan.

The transformers are arranged in cells, and are provided with forced oil circulation, and the switchgear, high and low tension, and hydraulic earthing devices are disposed on the various floors of the building. The outgoing 88,000-volt overhead lines start from two towers erected on the roof. In the generating station itself are four turbine-driven alternators, each of a capacity of 5,650 kw., two exciter sets of 440 kw., and there are in all nine transformers, each for 3,600 kw. The main turbines are of the Francis type, designed for a fall of 76 metres, of which 7·5 metres is suction. These sets run at 420 r.p.m., and can work on overload up to 7,360 kw. They are provided with oil-pressure governors controlled electrically from the switchboard. The 440-kw. exciter sets run at 630 r.p.m., and are driven by turbines of similar type.

The efficiency of the large sets is 87 per cent. on full load, and the governors limit the rise of speed on shutting off ¼, ½, or full load to 3·5, 6, and 12 per cent. respectively. The efficiency of the exciter sets is 79 per cent. The alternators are wound for 6,000 to 6,600 volts 42 cycles, and maintain an output of 7,200 k.v.a. at 0·8 power factor, with a temperature rise not exceeding 35° C. The overload temperature rises are given as 40° C. after continuous overload at 6,500 kw., 45° C. at 6,800 kw., and 50° C. after 7,360 kw. for two hours. The voltage drop on full load at 0·8 power factor is given as 25 per cent., or 10 per cent. at unity power factor, and the short-circuit current, which the machines can maintain for two minutes, as 2·4 times the normal at 0·8 power factor.

The main transformers, which step up to 88,000 volts, are in groups of three, with their primaries in mesh and their secondaries in star connection, with the neutral point earthed. Forced oil circulation with external water coolers for the oil is provided, but in event of stoppage of the oil pumps the temperature rise would not exceed 30° C. after four hours. The full load efficiency is given as 98·5 per cent. at unity power factor. The 88,000-volt switchgear is not enclosed in cells, as is the case with the 6,000-volt gear, on account of the much greater distance apart of the conductors. Other special features of the switchgear are its simplicity of arrangement, the extensive use of signal lamps, and the care with which the automatic circuit-breakers are graded according to their time limits to come out in their right order. The auxiliary services of the switchgear are supplied at 200 volts from the exciters, and a 6-kw. D.C. set serves as a stand-by for this purpose. A separate set of bus-bars, to which connections can be made by links, is provided for testing purposes, and a liquid resistance capable of dissipating 10,000 kw. is available. There are switches between the 88,000-volt terminals of the transformers and the outgoing lines. Horn type surge arresters are used with liquid resistances.

LOW-HEAD WATER-POWER PLANT AND EXPLOSIVE MANUFACTURE IN BAVARIA

AN enterprising engineer of Munich, by name J. Hallinger, has set afoot an agitation for the utilisation of the undeveloped low-fall water powers of Bavaria, which has aroused some considerable discussion, and his optimistic proposals, though based on sound engineering principles, have raised the scorn of the more conservative engineers. There is nothing vitally new in the suggestions, the principal one of which is the development of large sections of the more important rivers in one comprehensive scheme with one dam and one canal, with several power stations on it at suitable points, instead of a separate dam, intake, and canal for each power station.

One hotly-contested statement of the originator of the scheme is that the present schemes utilise only from 50 to 60 per cent. of the total fall, owing to the adoption of earth canals, whereas, if properly designed, concrete-lined canals were used, nearly 90 per cent. of the total fall could be utilised. Otherwise expressed, the usual gradient is 40 to 50 centimetres per kilometre, whereas, owing to the lower resistance to the flow, the concrete-lined canal works satisfactorily with 10 centimetres. Hallinger points to several existing developments in proof of this; his opponents contend that there are many earth canals working satisfactorily with 20 and 30-centimetre falls. The importance of this gradient is that on a gross fall or head of, say, one metre in one kilometre, a gradient of 10 centimetres results in exactly twice the developed horse-power that would be produced if the gradient were 55 centimetres, and the horse-power produced may be in figures of tens or hundreds of thousands, according to the quantity of water.

By securing this higher utilisation of the available head of water, by carrying the main canal along a route chosen irrespective of the route of the old river-bed (with branch canals to take in tributaries), by spacing the power-station units at suitable points decreed only by the contour of the land along the route of the canal, and by adopting certain improvements in the design of the power stations, Hallinger estimates that the capital cost per horse-power installed can be reduced from the present average figure of £30 to £15 per h.p. In opposition to this, it is pointed out that there are other features besides contours which control the position of the power station, that most rivers have existing developments which could not be embraced in a development of the type proposed, and that a concrete-lined canal costs about £15 per metre, as compared with £10 per metre for an earth canal in like circumstances, so that the conclusion that the installation cost can be halved is not justified.

Hallinger estimates, on the basis of official statistics, that over one million horse-power can yet be produced in low-head developments on the greater rivers of Bavaria, and he asserts, on the basis of the above-mentioned installation cost, that the energy produced could be sold for about 0·036d. to 0·084d. per kw.hr., which would enable the manufacturer of nitrates and other electro-chemical products to be carried out at a profit. In this connection, he refers to the efforts of Germany to provide a substitute for the 700,000 tons of Chile saltpetre annually imported before the war. The sulphate of ammonia, manufactured chiefly by the Haber process (not an electrical process, but one which requires much coal and steam), now costs in Germany £12 10s. per ton, whereas he affirms that electrically manufactured saltpetre costs in Norway, where water power is utilised for this purpose, only £4 per ton. Further, nitric acid, manufactured by the Haber process, which is required for the manufacture of explosives, now costs in Germany about £25 per ton (medium market strength), whereas it is produced in Norway for £6 to £7 per ton with hydro-electric power.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published August 3rd, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

26,934/13. **Wireless Telegraphy.** Soc. Marius Latour et Cie. A system of transformation of frequency of alternating currents to a value high enough for the direct feeding of the aerial by a machine having a monophase winding on its rotor, and a polyphase winding on its stator connected to the antenna by a self-inductive coupling and a capacity situated respectively in each of the phases creating a wattless current in advance in one phase, and lagging in respect of the other phase, and approximately the same intensity in both phases. (Two figures.)

10,433/15. **Textile Machine Drive.** Siemens-Schuckertwerke. A separate driving arrangement for spindles by synchronous motors in which, after the spinning has commenced, the periodicity and the potential of the current are gradually varied according to the variations required in the driving moment. (One figure.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: British Insulated & Helsby Cables, Ltd., and Astley [Cable suspension] 11,172/15.

Dynamos, Motors, &c.: G. A. Mower and Sturtevant Engineering Co. [Air filters] 4,063/16 (*100,876*).

Electrometallurgy and Electrochemistry: Lane and Honeyman [Rumblers for electrolytic purposes] 10,785/15.

Ignition: L. Renault [Automatic control of ignition] 1,766/16 (*100,868*).

Switchgear, Fuses, and Fittings: Schattner, Travis, and Walton [Motor starters and controllers] 10,752/15; Guth [Lamp holders] 11,723/15; Igranic Electric Co. (*Cutler-Hammer Mfg. Co.*) [Motor controllers] 1,643/16 (*100,872*).

Telegraphy and Telephony: Redman [Apparatus for detecting submarine sounds] 16,407/15; F. Aldendorf [Electro-mechanically controlled telephone exchange system] 4,699/16 (*100,859*).

Traction: Davies [Railway signalling] 11,804/15; A. Kerr [Railway signalling] 3,002/16 (*100,356*).

Miscellaneous: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Windings] 11,263/15 and [Rectifiers] 12,666/15; Lewis [Electric brakes] 13,679/15; Braddock and Pickles [Mine signalling] 13,789/16; Woods [Electric lighting means] 288/16 (*100,879*); J. W. Mander [Pocket lamps] 6,302/16 (*100,863*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Switchgear, &c.: British Westinghouse Elect. & Mfg. Co. [Time limit relays] 9,826/16 (*100,892*).

Miscellaneous: Wilson [Electric welding] 18,114/15; British Westinghouse Elect. & Mfg. Co. [Method of producing asymmetrical potential waves] 9,927/16 (*100,893*); M. Breslauer [Unipolar dynamo-electric gears] 9,937/16 (*100,895*).

Application for Suspension of Enemy Patents

9,499/12 and 13,903/13. **X-ray Working.** Siemens & Halske A.G. Licences having been granted in respect of the applications of Watson & Sons (Electro-Medical, Ltd.) under both these patents, which relate to a system of current supply to X-ray tubes involving the use of a revolving contact maker.

Application for Restoration of Lapsed Patent

13,719/08. **Induction Motors.** J. C. B. Ingleby. An application has been made for the restoration of this patent which has become void owing to non-payment of renewal fees. Opposition must be lodged before Sept. 26th. The specification describes a construction of squirrel-cage rotor in which the end connections also act as fan blades.

Application for Revocation

18,780/14. **Mine Signalling.** H. Green and W. de M. Landon. An order has been made by the Comptroller requiring an amendment in this specification, which is for a system of electrical mine shaft signalling.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

17,703, 17,705, 17,706, and 17,708. **Wireless Telegraphy and Telephony.** R. A. Fessenden. These patents relate respectively to a system of directive wireless transmission, a selective system employing several frequencies, a wireless telephone system, and a long wave transmission system.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors and Transformers: H. A. Mavor and Mavor & Coulson [Ventilated enclosed mining motor] 9,133/09.

Telegraphy: T. Ritchie [Telautographs] 9,010/07.

Accidents on Electric Railways.—The general report to the Board of Trade upon accidents that have occurred on the railways of the United Kingdom during 1915 contains no record against electric railways of accidents due to the movement of trains. There were, however, 2 railway servants killed and 36 injured through contact with live rails or overhead wires compared with 10 injured in 1914 and 2 killed and 14 injured in 1913. The increase in 1915 was principally due to the working of lines newly equipped for electric traction, 14 cases (one fatal) occurring on the recently electrified lines of the London and South-Western Railway.

The Electrical Contractors' Association.—The August issue of the *Electrical Contractor*, the official journal of the Electrical Contractors' Association, is a special propagandist number in which the objects of the Association are dealt with at length, and a review given of the work which has been carried out by it in the past. A feature of the issue is a number of personal opinions from members pointing out the material advantages they have obtained as a consequence of their E.C.A. membership. The parliamentary and legal work of the Association is dealt with by Mr. R. Tweedy Smith, the honorary solicitor, who himself also comes in for an appreciation for the considerable amount of work that he has done on behalf of the Association from its very commencement.

The University of Manchester.—The prospectus of the University Courses in the Municipal School of Technology, Manchester, for the 1916-17 session has come to hand. It is issued, however, subject to the proviso that the number of lectures in the courses may be diminished owing to rearrangements rendered necessary by the war. The electrical engineering course runs over three years, and is under the supervision of Professor Miles Walker, Professor of Electrical Engineering in the University and in the School of Technology. The term commences on October 5th.

"Lektrik Lighting Connections."—Messrs. A. P. Lundberg & Sons (477 to 489 Liverpool Road, London, N.) have issued a French edition of their extremely useful booklet, "Lektrik Lighting Connections." Beyond the omission of opinions of central station engineers, the list of advanced grade certificate holders, and of the table of wires, this French translation covers exactly the same ground as the English original. This French edition brings the total number printed up to 37,000 copies, which affords some proof, at any rate, of the practical value of the contents.

The British Association.—The annual meeting of the British Association for the Advancement of Science this year will be held at Newcastle from September 5th to 9th. Sir Arthur Evans, F.R.S., is president, and he will deliver his inaugural address in the Town Hall, Newcastle-on-Tyne, on Tuesday, September 5th, at 8.30 p.m. Among the evening discourses will be one by Professor W. A. Bone, F.R.S., on Thursday, September 7th, at 8.30 p.m., on "Intensified Combustion."

THE BOARD OF TRADE REGULATIONS

Revised Rules under 1888 Electric Lighting Act

THE Board of Trade has issued a slightly modified set of Regulations under Section 4 of the Electric Lighting Act of 1888. This Section relates to the laying of electric mains either underground or overhead, and the Regulations in question deal only with low pressure and medium pressure supply, namely, 250 volts and not exceeding 650 volts respectively. The existing Regulations were issued in 1908 and we indicate below the modifications.

There is a slight alteration in Regulation 10, it being laid down that the owner, *i.e.*, the body or person owning or using any electric line or works, shall on receipt of these Regulations, serve on the Postmaster-General *a statement containing full particulars of every electric line* used for the supply of energy, together with a plan showing the mode and position in which such line is laid. There is also a verbal alteration in Sub-Section (*b*) of the same Regulation to bring it into line with the italicised alteration above.

In the Section of the Regulations headed "Overhead Lines for Low Pressure and Medium Pressure, Continuous Current Supply and for Low Pressure Alternating Current Supply," an additional Regulation has been added dealing with earthed conductors, and Regulations 16 and 17 on this point read as follows:—

(16) Where alternating current at a pressure exceeding 125 volts between any two conductors is used, the middle point of the winding of the transformer on the consumer's side in the case of single-phase supply, or the neutral point in the case of two- or three-phase supply, shall be connected with earth.

(17) Where a medium pressure continuous-current supply, or where alternating-current supply at a pressure exceeding 125 volts between any conductor and earth is used, one conductor consisting of one or two continuous earthed neutral wires shall be carried from pole to pole. The other conductor or conductors shall be arranged in such a manner that in the event of breakage of one of them, it must make contact with the earthed conductor or with wires connected thereto.

The Section headed in the old Regulations "Compulsory Connection of a Three-Wire System with Earth" has now the heading "Connection of Continuous Current Circuits with Earth," and the Regulations now provide that the connection with earth of the intermediate conductor shall be made at one point only on each distinct circuit, namely, at the *generating station or sub-station*. In the old Regulations the connection was to be either at the generating station, sub-station or transformers.

The Section of the old Regulations headed "Optional Connection of other Circuits with Earth" has been changed to "Connection of Alternating Current Circuits with Earth," but the Regulations in this Section remain the same, except that they start off by saying "Alternating current circuits shall be connected with earth in accordance with the following conditions."

A separate Section, however, is added for "Connection of Concentric Mains with Earth," and more detail is gone into on this point than in the previous Regulations, as set out below:—

(27) Concentric mains used either for continuous or alternating current shall be connected with earth by means of the external conductor in accordance with the following conditions:—

(*a*) The connection with earth shall be made by means of the external conductor.

(*b*) The connection with earth shall be made only at the point or points where energy is given to each distinct circuit, namely, at a generating station, sub-station, or transformer.

(*c*) The insulation of the external conductor shall be efficiently maintained at all other parts.

(*d*) The external conductor shall form a complete metal sheathing round the inner conductor.

(*e*) The connection with earth shall be efficiently maintained except when it is interrupted by means of a switch or link for the purpose of periodical tests for ascertaining whether any current is passing by means of the connection with earth.

(*f*) Tests shall be periodically made to ascertain whether any current is passing by means of the connection with earth, and if at any time the current passing by means of the connection with earth exceeds one-thousandth part of the maximum supply current of the circuit, steps shall be immediately taken to improve the insulation.

LOCAL NOTES

Blackburn: *Proposed New Electricity Works.*—At the last meeting of the Corporation it was stated that a site has been chosen for a new electricity works and a complete scheme drawn up in connection with it. For obvious reasons, however, any progress with it for the present is unlikely.

Chelmsford: *Street Lighting and Charges.*—The Lighting Committee has recommended that a new contract be entered into with the Electric Supply Corporation for so much street lighting as the present lighting restrictions allow, on the understanding that the opposition to the Council's application to the Board of Trade for extension of one year, in which the Council may exercise its option to purchase the Company's undertaking, is withdrawn.

Edinburgh: *Inspection of Stage Fittings.*—Hitherto it has been the practice in Edinburgh for one of the staff of the Electric Supply Department to pay weekly visits to the various theatres to inspect the stage electrical fittings. One of the conditions has been that no performance can take place until this weekly inspection has been made. This has been done without charge to the theatre proprietors, but it has now been notified that a charge will be made. Objection has naturally been taken, and inquiries are being made as to the practice in other towns.

King's Lynn: *Electricity Accounts.*—After meeting capital charges and war service allowances there was a net profit of £1,018 last year, compared with £1,350 in the previous twelve months.

Llandudno: *Electricity Deficit.*—In connection with a loss of £1,490 on the electricity undertaking last year, the Electricity Committee calls attention to the fact that about £4,000 had been contributed from profits to rate relief in the past, and recommends that £1,225 of the deficit be taken from reserve, the balance being made up from the rates.

London: *Marylebone: Electricity Accounts.*—There was a net profit of £2,371 on the working of the electricity undertaking last year against a deficit of £7,057 for the previous twelve months. The financial position in the future will be still more improved by the fact that one of the earlier loans was fully paid off in May, 1916, the effect of which will be to reduce the net revenue charges in future by £5,358 per annum. Notwithstanding a further falling off in the sales for lighting purposes, there was a slight increase in the total output, namely, 16,069,870, against 15,926,167. The Publicity Department shows a credit balance of £479 against a debit balance of £2,339 in the previous year.

Southwark: Electricity Deficit.—There was a loss of £6,679 on the working of the electricity undertaking last year. In reporting this at the last meeting of the Council the Chairman of the Electric Lighting Committee stated that a conference had taken place with the Bermondsey Borough Council with a view to supplying that district with electricity in bulk, but nothing practical had resulted. As to the present unsatisfactory position of the Southwark undertaking, he stated it was evident that some scheme to put all consumers on a varying scale to meet the increasing cost of coal or variations from year to year is essential if the undertaking is to be placed upon a sound financial basis.

Londonderry: *Price of Coal.*—The Borough Electrical Engineer reports that, whereas the average price of coal during the financial year just completed was 22s. 7d. per ton, he has been compelled to arrange contracts ranging from 30s. to 36s. per ton for the current year.

Oldham: *Two-rate Meter Supply.*—Attention was called at the last meeting of the Corporation to the fact that the clocks on the 2,000 two-rate meters used by the Electricity Supply Department have not been put back the hour in accordance with the Summer Time Act, and thus consumers were paying the higher rate for an hour longer than they should do. On behalf of the Electricity Committee it was stated that it was impossible to alter the 2,000 clocks in the limited time allowed between the passing of the Act and its coming into force, and, moreover, in any event the Committee was not disposed to do so until it was decided whether the Summer Time Act was to be a permanent measure or was only to apply this year. Nevertheless, very few complaints had come through direct to the Department from the two-rate meter consumers, and any who were dissatisfied had the option of applying for a flat-rate supply.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Loughborough.—An application is to be made for sanction to borrow £7,000 in connection with additional supply to the Brush Electrical Engineering Co.'s works.

Manchester.—The Electricity Committee require hoist gear, motor, cage and hoist well complete for ash-handling plant. Chairman, Electricity Committee, August 15. Further particulars from Chief Electrical Engineer.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Aberdeen.—A turbo-alternator is to be purchased from Messrs. C. A. Parsons & Co. at £18,000.

Barrow-in-Furness.—A tender by the British Westinghouse Co. for a 150-kw. rotary converter at £735 has been accepted.

London: *Hammersmith.*—The Borough Electrical Engineer has reported the absolute necessity for further transformers owing to the increased load upon the undertaking, which is now 1,200 k.v.a. higher than at this period last year. In July, 1914, the Council entered into a contract with the British Electric Transformer Co. for supplying transformers, including 200-kw. machines at £125 each. In October, 1915, the price was revised to £134 7s. 6d., and the Company is prepared to supply further transformers subject to an increase of 12½ per cent. on this price, and also subject to a sliding scale dealing with the market price of electrolytic copper. The last transformer price was based upon copper at £88 per ton, and this is to be taken as the basis. For each variation up or down of 3 per cent. there will be an increase or decrease of £1 in the price of the completed machine. Five 200-kw. transformers are to be supplied at once on these terms.

L.C.C.—The following tenders have been received for the electric wiring and fitting of the County Secondary School, Forest Hill:—Alex. Hawkins and Sons (accepted), £572 5s.; Alpha Manufacturing Co., £578 5s.; H. J. Cash & Co., Ltd., £619 15s.; W. C. Tackley & Co., £671 10s.; Tredegars, Ltd., £864.

Manchester.—The Electricity Committee report their inability to obtain a supply of boiler tubes except from a firm 99 per cent. of whose capital is held in Germany. The English works of the company are a controlled establishment under the Munitions of War Act, and the Electricity Committee, being unable to come to a decision in the matter, left it to the Corporation. In the circumstances, the tender has been accepted.

New Zealand.—The Imperial Trade Correspondent at Dunedin reports, says the *Board of Trade Journal*, that, in view of the present unsatisfactory conditions as regards prices and shipment of material, none of the tenders recently for the supply and delivery of six electric tramway cars and other sections of cars have been accepted.

APPOINTMENTS AND PERSONAL NOTES

The will of the late Professor Silvanus P. Thompson, F.R.S., Principal of the Finsbury Technical College, has been proved at £8,444.

Sir Alexander B. W. Kennedy, F.R.S., Chief Engineer to the Westminster Electric Supply Corporation, has also been appointed Chief Engineer to the St. James's and Pall Mall Electric Light Co., in succession to the late Mr. S. T. Dobson, who was accidentally drowned in Poole Harbour early last month. The St. James's and Westminster Companies have already, of course, close working arrangements.

Mr. S. T. Smith, Manager of the electricity and gas undertakings at Malvern, has been granted an increase of £50 per annum in his salary.

Particulars of a number of appointments appear in our advertisement pages.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £122 to £126 (last week, £123 to £127).

Liquidations.—The last day for receiving proofs in the winding-up of the Adnil Electric Co., Ltd., is August 16th. The liquidator is Mr. J. H. Stephens, 6, Clement's Lane, E.C.

The G.E.C. Cadet Corps.—On Saturday, August 5th, an inspection of this corps, which is formally known as the 1st Cadet Battalion Sussex Yeomanry, "G," London, Company, was held on Hampstead Heath. The Corps was under the command of Capt. E. A. Joyce, and gave an excellent display of company drill and field manœuvres, culminating in an enveloping movement which was carried out with a high degree of skill and intelligence. Afterwards the Corps marched to "Springmead," the residence of the Chairman of the General Electric Co., Ltd., where they were entertained to lunch and tea. The afternoon was spent in a variety of sports, including several boxing matches, which were keenly enjoyed by a number of wounded soldiers who had also been invited. The band of the 19th Battalion King's Royal Rifles was in attendance. The weather was perfect, and the members thoroughly enjoyed themselves.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

London Supply Companies' Dividends.—The following interim dividends have been announced:—Metropolitan Electric Supply Co., one shilling per share; last year, 1 per cent.—London Electric Supply Corporation, 5 per cent. per annum.—Charing Cross, West End & City Electricity Supply Co. (West End undertaking), 4 per cent. per annum; last year the same.—Chelsea Electricity Supply Co., 3 per cent per annum less tax.—City of London Electric Lighting Co., 6 per cent. less tax; last year the same.—County of London Electric Supply Co., 5 per cent. less tax; last year the same. Westminster Electric Supply Co., 5 per cent. per annum, less tax; last year 6 per cent. Chelsea Electric Supply Co., 3 per cent. per annum, less tax.

Electric Supply Corporation.—At the annual meeting last week the Chairman stated that the Company is relying, in regard to the street lighting contract, upon the recent judgment of the Appeal Court, in which it was held that a company undertaking street lighting for a local authority is entitled to the full amount of its contract, notwithstanding the lighting restrictions. However, as pointed out in our "Local Notes" column, negotiations are proceeding with the Corporation for a renewal of the contract on the basis of a considerable allowance being made in regard to 1915.

NEW COMPANIES

BRITISH-ITALIAN CORPORATION.—This Company has been formed, with a capital of £1,000,000 in £20 shares, to carry on, subsidise, assist, or participate in financial, commercial, industrial, manufacturing, electrical, railway, navigation, land development, mining, and other businesses in the British Empire, Italy and elsewhere. The directors include A. Pirelli, 144 Queen Victoria Street, E.C., and, as was mentioned in the House of Commons last week, the British Government will subsidise the Company to the extent of £50,000 per annum, or 5 per cent. of the paid-up capital, if less, receiving in return certain dividends after a prescribed amount has been paid to the shareholders.

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SUMMARY

THE Sheffield Electric Supply Department last year increased its output by no less than 73·7 per cent. There was a net profit of £33,296 (p. 312).

IN view of the shortage of copper in Germany, extensive use is being made of zinc and aluminium in the windings of dynamos, motors, and transformers. A new set of rules has been issued giving the conditions under which these substitutes are to be used (p. 312).

CONSIDERABLE progress has been made with the equipment of the L. & N.W. Railway Co.'s suburban lines for electric traction. About eighty miles of track are involved, and the centre of the system is Willesden, from which branches radiate to Watford, Broad Street, Euston, Earl's Court, and Richmond. Some parts of the system are now in operation, and others are expected to be completed in the near future (p. 313).

SOME notes are given on the equipment of a steep grade heavy mineral railway in America where single-phase transmission is used with phase converters and three-phase motors on the locomotives (p. 314).

CALCULATIONS of the sizes of cables necessary for wiring an induction motor stator and rotor under various conditions of load are given in our "Questions and Answers" columns (p. 315).

AMONG the subjects of specifications published at the Patent Office last Thursday were motor controllers, transformers, and submarine signalling. A revolving stage patent and a multiple unit train control patent expire this week after a full life of fourteen years (p. 316).

A NUMBER of books are reviewed on p. 316.

THERE was a profit of £7,000 on the Greenock electricity last year and £5,317 at Glasgow. At Yarmouth there was a loss of £6,219 (p. 317).

GENERATING plant is required at Barrow-in-Furness, Burton-on-Trent, Ashton-under-Lyne, and Rochdale (p. 317).

A 10 per cent. interim dividend for the June half-year is recommended by W. T. Henley's Telegraph Works Co.—Considerable progress is now being made by the Metropolitan Electric Supply Co. (p. 318).

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE.

ORDERS FOR AUGUST, 1916, BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Headquarters and Range.—The Headquarters will be closed during August, except on Tuesday evenings. The range will be open on Thursday evenings only. On these evenings the Sergeant-Major will take charge and be responsible for the maintenance of order and discipline. Recruits are urged to take advantage of this arrangement for drill and shooting.

Instruction Classes.—Instruction classes at Regency Street will be held as usual for Platoons Nos. 9 and 10.

Camp.—The Camp at Otford will be available until August 31st. Members wishing to attend should enter their names at Headquarters on the sheet provided for the purpose. The cost will be about 3s. per day. Members should provide themselves with 2 blankets, knife, fork, spoon, plate, mug, and a spare pair of boots.

Entrenching.—As many members as possible should endeavour to attend the Sunday Entrenching Parades, in order that the work to be done may be completed as expeditiously as possible. Parade in Uniform, as usual, at Victoria Station (S.E. & C. Rly.) Booking Office, 8.45 a.m. Members are reminded that this work is of national importance, and, therefore, all who are able to put in Saturdays and occasional week-days are urged to do so. They are reminded that they can obtain railway vouchers from the booking clerk by showing their cap badges.

THE BRITISH ASSOCIATION

AS we have already mentioned, the annual meeting of the British Association will be held this year at Newcastle-on-Tyne from September 5th to 9th.

Although the official programme of the various sectional meetings is not yet ready, we are able to give below the programme of Section G (Engineering):—

Limit Gauges, by Dr. R. T. Glazebrook.

Principles of Similitude, by Dr. Stanton.

Standardisation and its Influence on the Engineering Industries, by the Secretary of the Engineering Standards Committee, with a foreword by Sir John Wolfe Barry, K.C.B.

The Design of Elements of Structures and Machines by Experiments with Polarised Light, by Prof. Coker, D.Sc.

The Influence of Pressure on Ignition, by Prof. W. M. Thornton, D.Sc.

The Calculation of the Capacity of Aerials, including the Effects of Masts and Buildings, by Prof. G. W. O. Howe, D.Sc.

Some Characteristic Curves for a Poulsen Arc Generator, by Mr. N. W. McLachlan, M.Sc.

The Engineering and Chemistry Sections will hold a joint meeting to discuss the report of the Committee on Fuel Economy, which was appointed at last year's meeting at Manchester.

Technical College Announcements.—The Handbook in the Faculty of Engineering, University of London, University College, Gower Street, has been issued, and contains full particulars of the arrangements and fees. The electrical engineering course under Prof. J. A. Fleming, F.R.S., assisted by Prof. W. C. Clinton, runs into three years, and, incidentally, it may be mentioned that the course on electrical design is open, not only to regular students, but to electrical engineers engaged elsewhere during the day. The 24 lectures in this course are given on Tuesdays from 5 to 6.45 p.m. The first term of the 1916–1917 session commences on October 2nd.

Utilisation of Peat.—A considerable discussion has been proceeding in the United States on the subject of the conservation and utilisation of the natural resources of the country, including the large supplies of peat which exist in Wisconsin, Minnesota, and other States. The probabilities of commercial success for power-houses using this source of fuel are pointed out by the *Electrical Review and Western Electrician.* It is said that one ton of peat will produce 750 kilowatt-hours of energy, 125 lbs. of sulphate of ammonia, and 35 gallons of tar, and that the two latter products are worth enough to cover the entire cost of operation, leaving the energy developed as a clear profit from the operation. The German Government has spent large sums of money in investigating the use of peat from the extensive moors in the neighbourhood of Bremen. An experimental station was constructed, and it was found possible to use the peat in generating power through the medium of gas producers and gas engines. A number of cities and a large rural district are now supplied by power from this source, and the by-products are utilised—the tar as a fuel in operating the gas producer, and the ammonia sulphate as an important source of nitrogen supply. Russia and Italy are making similar use of their extensive peat bogs.

THE SHEFFIELD ELECTRICITY UNDERTAKING

A 73 per cent. Increase in Output

Although the position of the Sheffield electric supply undertaking has been the cause of a good deal of discussion just recently, particularly in connection with the confidential report by the General Manager upon the financial position (Electrical Engineering, July 20th, p. 282), there is little doubt that it is making exceptional progress from the business and technical point of view. The number of units sold last year shows an increase of no less than 73·5 per cent. over the number sold during the previous twelve months, records for output having been made throughout the year. The revenue has increased from £184,658 to £277,580, but as the whole of the increased output represents sales for power and traction purposes at low rates, the growth of the revenue was obviously not in the same proportion as the growth of the number of units sold, the total average price received having fallen from 0·97d. to 0·85d. per unit. After meeting capital charges, including £10,030 on unproductive capital, there was a net surplus for the year of £33,296, to which is added the accumulated surplus of £6,982, making a total of £40,278. The allowances to men on active service and their dependants amounted to £2,247. The Electric Supply Committee recommends that this surplus be disposed of by transferring £39,778 to renewals and special expenditure fund, and £500 to the motors hire fund. At the end of the previous financial year the balance was £32,725, of which £14,000 was transferred to renewals and special expenditure fund, £10,000 to reserve, £500 to motors hire fund, and £1,243 to depreciation of emergency coal, leaving the £6,982 to be carried forward as mentioned above. The percentage of working expenses to total revenue is 53 for 1915–16, against 43 for the previous year, but this is wholly due to the increased cost of coal, all other items in the cost of generation and distribution showing a decrease in cost per unit. The coal bill amounted to £88,041, an increase roughly of no less than £69,500. Large extensions to the building and machinery at Neepsend have been put in hand, and 28,000 kw. of additional plant is now under consideration or completed. The number of consumers increased by 409 during the year, making a total of 7,318, and the total connections amount to 83,834 kw., or 17,691 kw. more than at the end of the previous year. Applications in hand now waiting connection amount to 8,000 kw.

Similarly, the Installation and Motor Department has had a record turnover, the amount for the year being £36,857. The department has been responsible for the installation of 10,480 h.p. of motors, as compared with 3,339 h.p. in the previous year—figures which again go to show the enormous extent to which Sheffield is contributing to the demands of the times.

The Committee recommend and, as will be seen below, the Corporation have adopted, that commencing with the September readings all accounts should be increased by 10 per cent. where the present price is more than 2d. per unit and 20 per cent. where the present price is 2d. per unit or less. The increased charges are also to apply to the tramways undertaking.

At the last meeting of the Corporation, when a considerable amount of time was spent discussing the Electricity Department, the proposed increased scale of charges received practically unanimous approval, although one or two members of the Council did not think it worth while disturbing lighting consumers for the small amount which would be obtained from them. Incidentally, some astonishment seems to have been caused by the allegation that the accounts of the electricity undertaking were not in proper form, and that although the City Treasurer's name was appended to them, he had not actually seen and approved them. In the circumstances, it was agreed that the accounts should go back to the Electric Supply Committee and that the whole position should be discussed with the Finance Committee. There was also some discussion as to the cost of tramway power, the supply of which, it will be remembered, is now in the hands of the Electric Supply Department, the Tramways Department having given up the control of the Kelham Island power station a short time ago. Sir William Clegg read a statement by the General Manager of the tramways to the effect that the tramway current cost £6,000 more last year than if the Tramway Department had retained its generating station. No statement as to this, however, was made on the other side.

THE GERMAN COPPER FAMINE

Substitutes in Machines and Transformers

A revised set of rules has been issued by the Verband Deutscher Elektrotechniker for the utilisation of substitutes (Ersatzmetallen) in machines and transformers in view of the shortage of copper. Regulations are already in force regarding the use of substitutes for cotton for insulation. In many cases machines and transformers can have their windings partly or entirely of zinc or aluminium, slip-rings and commutators of iron, but the same guarantees of performance cannot, of course, be given. The regulations urge this employment of substitutes wherever possible, but lay down certain limitations and conditions, and during the war an extra temperature rise of 10° C. is allowed above the usual standards.

Induction motors up to 0·3 kw. up to 1,000 r.p.m. are allowed to have copper windings. From 0·3 to 10 kw. the stator winding is to be aluminium, the rotor winding zinc or aluminium. From 10 to 80 kw. of zinc, and from 80 to 175 kw. of aluminium. Slip-rings are to be made of iron. Three-phase alternators and synchronous motors up to 70 k.v.a. are to have zinc windings, 70 to 250 k.v.a. aluminium, and over 250 k.v.a. copper or aluminium, slip-rings to be of iron and damping windings aluminium or copper. For single-phase motors the limits of size are 2/3 of the above. Copper may be used for continuous-current machines up to 2 kw., from 2 to 10 kw. field coils are to be of aluminium, from 10 to 35 kw. all windings of aluminium, from 35 to 175 kw. zinc field coils and aluminium interpole and armature windings, above 175 kw. aluminium fields and interpoles and copper armatures. Commutators to be of iron from 2 to 175 kw., otherwise of copper. D.C. machines under 100 or over 550 volts and over certain speeds in relation to their size are to have armature and interpole windings of copper with aluminium field coils, and in other special cases copper may be allowed. Distributed compensating windings are to be of the same material as specified for armatures. Rotary converters are under the same conditions as D.C. machines, except that copper must not be replaced by other material for commutators, slip-rings, or damping windings.

For transformers up to 15 k.v.a. aluminium can be used for all pressures up to 30,000 volts; from 15 to 25 k.v.a. zinc windings are specified up to 15,000 volts, and aluminium from 15,000 to 30,000 volts; from 25 to 50 k.v.a. the use of zinc is extended up to 20,000 volts; and from 50 to 250 k.v.a. up to 30,000 volts. Above 250 k.v.a. aluminium only is to be used, or copper in special cases. For very heavy current transformers or those subject to exceptional overloads, copper may be used for the low-tension winding. For single-phase transformers the limits of size are 2/3 of the above.

A.C. commutator motors are under similar rules to D.C. machines, except that the commutators are to be of copper. Crane, traction, and lift motors (D.C.) over 2 kw. to have copper armature windings, aluminium field coils, and copper commutators. Three-phase motors for these classes of work to have aluminium stator and rotor windings and iron slip-rings. Brake magnets in the smaller sizes are to be wound with zinc, and in the large sizes with aluminium. Choking coils in general follow the same rules as transformers. Choking coils for surge prevention to be of aluminium.

A list of exceptions to the above rules carries the matter into further detail in true German style, the general trend of which is that machines the reliability of which is of special importance, such as for colliery pumping, or liable to very hard usage and shocks, such as rolling-mill motors, &c., are not to contain zinc, although aluminium may be used to a certain extent. Copper is also allowed for machines which have to be exceptionally light or compact. Neither aluminium nor zinc are allowed in motors for chemical or explosive factories.

The Beck Searchlight.—The *New York Tribune* states that the General Electric Co. of America has constructed a five-foot projector with a Beck lamp, the beam of which is visible 200 miles away. It will be remembered that in this lamp, which was developed in America, the carbons are inclined at a special angle, are of very small diameter, and are continuously rotated while bathed in a hydrocarbon vapour. It is being adopted after extensive tests by the U.S. Navy. The *New York Tribune* states further that Heinrich Beck, the inventor of the lamp, was in America at the outbreak of war, but sailed for Antwerp *en route* for Germany in August, 1914. He was, however, taken off the ship by a British cruiser, but permitted to return to New York.

ELECTRIC TRACTION ON THE LONDON AND NORTH-WESTERN RAILWAY

IN spite of war conditions, the conversion of the suburban lines of the London and North-Western Railway to electric traction is making considerable progress. The lines in question are the Euston and Watford line, together with the North London branch from Broad Street to Willesden. The centre of the system is Willesden. From here the L. and N.W. main line runs west to Watford and east to Euston through Queen's Park, where the Bakerloo Tube branches

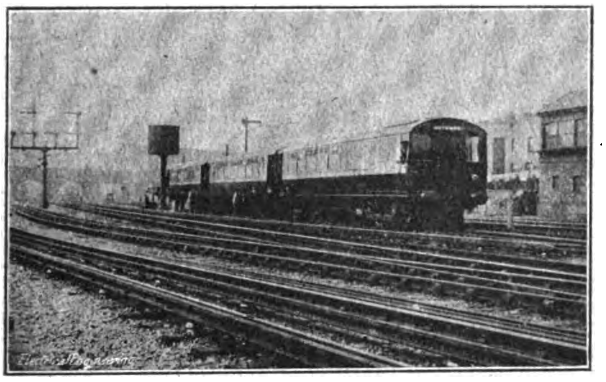

FIG. 1.—TRACK CONSTRUCTION AND OERLIKON THREE-COACH TRAIN.

off. Another line, owned jointly by the L. and N.W. and L. and S.W., runs south to Kew and Richmond, and a short branch runs south-east to Earl's Court. The Hampstead Junction Railway, owned by the L. and N.W., runs north-east from Willesden to Kentish Town, and is continued to Broad Street by the North London Railway. The electric trains on the Earl's Court branch have been running for some time, and through services have been established between the Bakerloo line and Willesden. The whole scheme involves the equipment of about eighty miles of line, and it will probably be the end of 1916 before the work is completed, although electric trains may be running between Willesden and Watford and over the North London branch in the near future. It is expected that a 10-minutes' service will eventually be put into operation between Euston and Watford. A successful trial trip has already been run between Broad Street and Richmond, and this section may be in operation by October 1st. The time occupied by this journey will be reduced from one hour, which is the time taken by the present steam trains, to forty-five minutes.

The magnitude of the undertaking is apparent from the amount of civil engineering work required. This includes the construction of entirely new permanent way between Euston and Watford, whilst new tunnels have been necessary at Kensal Green and Primrose Hill. There are two new single-track tunnels, each 16 ft. 4 in. in internal diameter, at Kensal Green, these being the largest in this country which have been constructed by the shield method. They have, of course, been in use for some time by the through trains from Elephant to Willesden. The Primrose Hill tunnels are not yet completed; they are being driven from the Loudoun Road end, and will be nearly a mile in length. Further heavy work has been necessitated at Chalk Farm, where the widening has entailed the building of a length of 1,100 ft. of new retaining wall, and the construction of a steel lattice girder bridge, of 120 ft. span, over Regent's Park Road. A new station has been built at Kensal Green and several between Willesden and Watford, whilst some of the existing stations have been reconstructed.

The track, which we have previously described (see ELEC. ENG., Vol. X., pp. 24 and 303), is fitted with third and fourth rails, the latter being between the running rails, which are themselves available for track circuit signalling. The conductor rails are manufactured of special low-carbon steel, weighing 105 lb. per yard, and with a resistance equal to six and a half times that of copper of equal section; they are mounted on Doulton porcelain insulators, which are fixed by malleable iron clips to the sleepers, whilst, to prevent creeping, anchor insulators are provided at intervals. Bonding is effected at each joint by four flexible copper strips, with drop forged heads fixed in place hydraulically. At cross-overs the rail sections are connected by jumper cables in bitumenised fibre troughs, the insulation of the cables being sealed by patent sealing terminals designed by Lieut.-Col. Cortez-Leigh (Chief Electrical Engineer to the L. and N.W. Railway).

The standard rolling stock comprises three-coach trains, each consisting of a motor-coach, one trailer, and a driving trailer, with control on the multiple unit system. Fig. 1 is an illustration of a standard train; an extra coach, either trailing or driving, is sometimes added. The electrical equipment of the trains is by Siemens Bros.' Dynamo Works, Ltd., and the Oerlikon Co. There are four 240 h.p. motors per coach. As the platform level on the Bakerloo tube is lower than that at the main line stations, the standard rolling stock will be a compromise between the L. and N.W. standard and the Bakerloo standard, so that passengers will step up to the platforms on the main line from the through trains and down to the platforms from the North-Western trains.

We have previously given, in the issues referred to above, some description of the power station, fig. 3, which is situated at Stonebridge Park. The plant here has now been at work for some time past, supplying power for the Willesden-Queen's Park Section, and for the lighting at Euston Station. The site of the power house is near Willesden, about the centre of the electrically worked system. The main buildings are steel-framed brick structures, running parallel to the railway lines which serve them. The boiler and turbine houses are side by side at one end, and the repair shops at the other. There are twenty Babcock & Wilcox boilers, with drop-link automatic stokers, super-heaters, and Green's economisers. They are arranged in two rows with a separate chimney stack for each. Each boiler is capable of evaporating

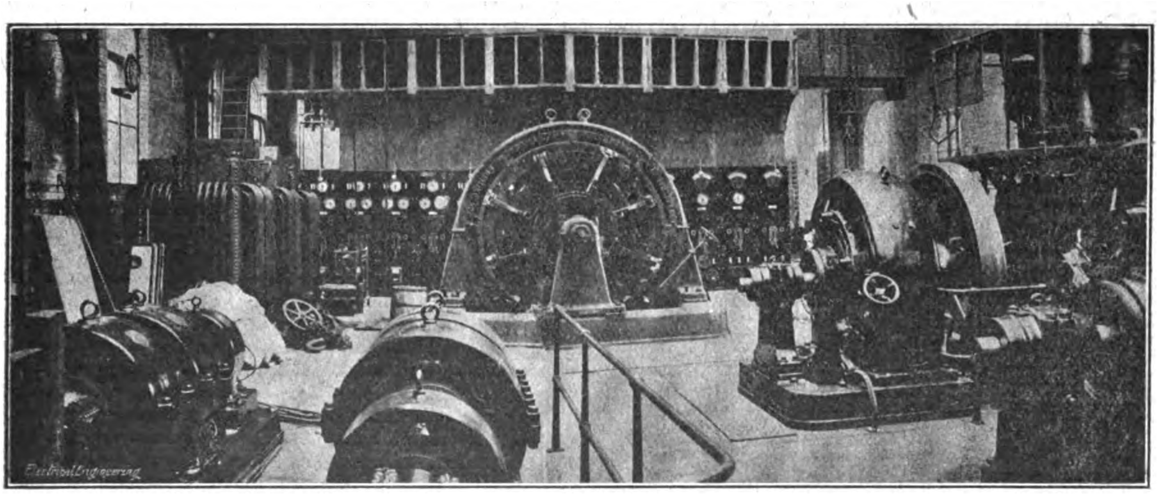

FIG. 2.—CAMDEN SUB-STATION. ROTARY CONVERTER AND THE DISPLACED GAS-ELECTRIC UNITS.

25,000 lb. of water per hour; steam is supplied at a pressure of 200 lb. per square inch and a superheat of 200 deg. F. An interesting feature is the coal and ash handling plant, also supplied by Babcock & Wilcox; this includes two tray-conveyors for bringing the coal from a large storage ground at the end of the power house site, and two bucket conveyors for elevating coal to the top of the boiler house and conveying it to the bunkers. A pneumatic system is adopted for dealing with ashes and soot. The whole sequence of operations from the time the coal is discharged from the railway wagon until the ash is finally disposed of is automatic. The site is of sufficient area to allow of the plant capacity being more than doubled, and the coal storage will accommodate a supply of some 20,000 tons of coal; a considerable extra quantity could also be stored in the immediate vicinity. In the generating room are five Westinghouse turbines coupled to 5,000 kw. Siemens' three-phase alternators, which generate current at 11,000 volts, 25 cycles,, the high-tension switchgear being provided by the British Thomson-Houston Co. (Rugby). A low-voltage unit is also installed for driving the auxiliary machinery and for lighting and other purposes. The condenser air-pumps are driven direct by small steam turbines. The auxiliary unit is a combined set, including a 440-volt alternator and a 220-volt d.c. generator and exciter for the alternator, all mounted on one shaft. The output is 500 kw. A.C. and 120 kw. D.C. Most of the auxiliary motors are supplied direct from the high-tension bus-bars through transformers. At times of low load, when the main units are

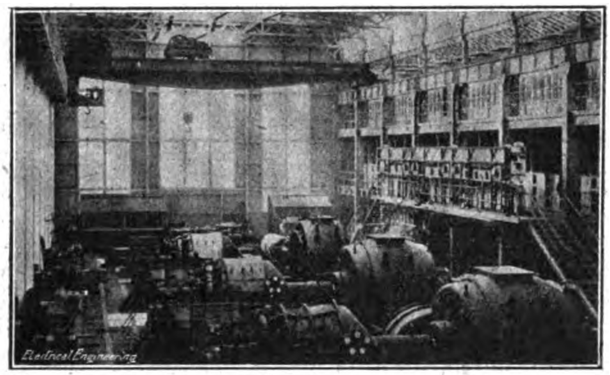

Fig. 3.—Interior of Main Power-house at Stonebridge Park.

shut down, the small set will supply current for the auxiliary plant, or even to the sub-stations, by stepping up to 11,000 volts.

There are eleven sub-stations on the system, situated at Bushey, Headstone Lane, Kenton, Willesden Junction, Queen's Park, West End Lane, Camden, Dalston, Broad Street, South Acton, and one at the power house. The small gas-power station at Camden, the interior of which is illustrated in fig. 3, is converted into one of the sub-stations, and it is intended that when the big units are shut down (on occasions when the electric trains are not running) the small set at the power house shall supply this station with current for the lighting of Euston. In each sub-station are three B.T.H. six-phase rotary converters, nine single-phase static transformers, a large storage battery, and an automatic reversible booster. The converting units are to be 750 kw. and 1,000 kw., with a large overload capacity, the machines being of the self-synchronising type. The transformers are of the British Electric Transformer Co.'s oil-cooled type, and the British Westinghouse Co. are the contractors for the high and low tension switchgear (107 H.T. panels and cubicles and 140 L.T. panels and accessories, involving a cost of from £50,000 to £60,000. The high-tension cables are three-core, paper-insulated, lead-covered, and armoured, supplied by British Insulated & Helsby Cables, Ltd. The whole of the electrification is being carried out under the superintendence of Lieut.-Col. F. A. Cortez-Leigh, the Chief Electrical Engineer to the company.

Science and War.—An instrument for locating hidden guns, and devices for detecting and locating enemy aircraft and submarines, have been constructed and experimented upon at the City and Guilds (Engineering) College. Some of the latter devices have been tested at the Royal Aircraft Factory, Farnborough, and the Royal Flying School, Upavon. The Admiralty and War Office provided aeroplanes on several occasions for making tests on a large stationary device, and reports on the experiments have been submitted to both Government Departments.

ELECTRIC TRACTION NOTES

An example of electric traction employed to meet special circumstances and possessing some peculiar features is presented by the working of the Norfolk and Western Elkhorn grade line in West Virginia, described in the *Railway Gazette*. The section in question is about 30 miles long, with heavy curves and gradients, and is primarily used for the purpose of collecting from the mine sidings and yards in the coalfields the entire east-bound coal tonnage and transporting it over the summit to the classification yard at Bluefield; thence, after classification, it is shipped east to the various destination points. Through merchandise freight and passenger traffic over the electrified section is still worked by steam locomotives, while the electric engines are used as pushers or helpers up the gradients. The purpose of the company in electrifying this section is to increase the capacity of the railway by materially reducing the time required to handle trains and to provide a more economical and efficient service over the heavy inclines. To this end the heavy freight trains are worked with electric locomotives at a running speed up the gradients of 14 m.p.h. as compared with about 7½ m.p.h. under steam operation; and a further saving in time is also effected by the elimination of the delays steam trains have heretofore occasioned by occupying the lines while the engines are taking coal and water, one at a time, at the several stations. The effect of increased speed is especially marked at the single track Elkhorn Tunnel, where, on account of ventilation requirements, it has been necessary under steam operation to reduce the up speed in the tunnel to about 6 m.p.h. The heavy coal trains weigh 3,250 tons, and were formerly hauled up the incline by three steam locomotives of the heavy Mallet type. Under electric operation one electric engine takes the place of two Mallets over the division, or two electric engines take the place of three Mallets up the grades and handle the train at approximately double the speed. The speed at which the electric locomotives handle the trains on the 0·4 per cent. grade is 28 m.p.h. Single-phase traction is used, power being generated, transmitted, and distributed single-phase at 44,000 volts 25 cycles, and collected from the overhead trolley system at 11,000 volts. The locomotives, however, are equipped with phase converters, which, in connection with the main step-down transformers on them, transform the single-phase power of the trolley to three-phase power for use in the three-phase induction type traction motors. Thus, while retaining all the advantages of high voltage single-phase distribution and collection, the advantages of three-phase induction motors for these heavy traction mountain grade conditions are also secured. A.C. track circuit signalling is employed, and at signal section joints impedance bonds are provided which prevent the flow of 60-cycle signal current from getting past the insulated joint, but at the same time do not interfere with the flow of 25-cycle propulsion current. The telegraph and telephone lines have been moved some distance from the track to minimise induction troubles, and to limit earth-current leakage booster transformers are provided every mile. The locomotives, made up of two 135-ton units, have a 2-4-4-2 wheel arrangement, the two trucks being connected by a hinge joint. Each locomotive is equipped with eight traction motors of the three-phase induction type, with wound secondaries for 4-pole and 8-pole operation. The motors are cooled by air forced from the main ventilating duct, which also delivers air to the phase converter and to cooling towers for the liquid rheostats. There are two running speeds, 14 and 28 m.p.h. In starting, resistance is inserted in the secondary circuit of the motor by means of a liquid rheostat. For the 14-m.p.h. speed all motors are connected in parallel, having the eight-pole motor combination, and for the 28-m.p.h. speed they are also connected in parallel, but with the 4-pole motor combination. The locomotives are equipped with the unit switch type of control and arranged for the simultaneous operation of the two units from the control end of either. The control equipment is designed for alternating current, which is collected from the 11,000-volt line by pantagraph trolleys. This current is fed to the main transformers through an oil-type circuit-breaker. A phase converter is connected with the low-tension side of the transformer and runs continuously when the locomotive is in service. To its extended shaft are coupled a blower for cooling the motors, transformers, and other parts, and, through a clutch, the air compressor. The converter is an induction motor with a short-circuited or cage-wound secondary having two windings on

its stator, one to drive the rotor and the other to furnish current out of phase with the main supply current. The motor circuit of the primary winding of this converter is connected across the secondary of the locomotive transformer, and receives current at 725 volts. The arrangement of windings is such that, with the converter running, a current of 90° phase displacement is induced in the second winding on the primary of the converter. By connecting this displacement circuit to the middle tap of the main transformer, a three-phase current is produced. It is only necessary to convert a portion of the current used in the main motors, as a large portion comes directly from the main transformers. For starting the converter a single-phase series commutator type motor is mounted directly on the shaft of the converter. Two trolleys are mounted on the roof of each unit. On each unit there are four liquid rheostats, one for each motor. The length of the complete locomotive is 105 ft., and the weight on the drivers is 220 tons out of the total of 270 tons. With a 3,250-ton train on a one per cent. grade one locomotive can exert a draw-bar pull of 85,800 lb. at 14 m.p.h., and 114,000 for uniform acceleration, and the highest draw-bar pull recorded with the dynamometer has been 180,000 lb.

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,507.

A batch of 20 squirrel-cage motors is driving centrifugal pumps from the corporation supply. Their full load rated output is 20 h.p., 440 volts, 50 periods, 3-phase, 1,425 r.p.m., but it is found that when pumping a certain liquid, the h.p. required is only 5, and consequently the power factor is bad. Is there any method of improving this power factor which will not be an expensive matter? The motors are started by means of star delta starters with fuses.—"Power Factor."

(Replies must be received not later than first post, Thursday, Aug. 24th.)

ANSWERS TO No. 1,505.

What sizes of cable should be used to wire for stator and rotor of a 10-h.p., 440-volt, 3-phase, 50-cycle, star-connected, slip-ring motor—five minutes' rating? Longest run, 15 yards. What current would the stator carry at 50 per cent. overload, and would current increase in proportion to load? What current is the rotor likely to deal with at this overload? The cable is to carry 50 per cent. overload for 5 minutes.—A. C.

The first award (10s.) is given to "Control" for the following reply:—

The speed of the machine is not mentioned by "A. C.," but for a 10-h.p. 440-volt, 3-phase, 50-cycle, slip-ring motor running at 1,000 r.p.m. synchronous speed, we could assume full load efficiency and power factor of 81 per cent. and 82 per cent. respectively, which would give amps per phase

$$= \frac{10 \times 746}{0{\cdot}81 \times 0{\cdot}82 \times \sqrt{3} \times 440} = 14{\cdot}7,$$

and as the machine is star wound, the phase current would be equal to the line current.

The rotor current per phase and the line for a machine with rotor connected star would be approximately

$$= \frac{\text{Stator conductors} \times \text{Stator phase amps.}}{\text{Rotor conductors.}}$$

The number of rotor conductors depends on the manufacturer's standard design; for a machine of this size either four or six conductors per slot would be chosen, in order to give a satisfactory winding; assuming six conductors per slot, then we might expect a phase and line current of about 35 amps at full load.

At 50 per cent. overload neither rotor nor stator current will increase in proportion to the load for the simple reason that the power factor and efficiency will in all probability not be the same as under full load conditions, the power factor depending on the relative values of short circuit and magnetising current. Assuming, at 50 per cent. overload, efficiency and power factor as 80 per cent. and 79 per cent. respectively, the stator current per phase and line would be $= \frac{15 \times 746}{0{\cdot}80 \times 0{\cdot}79 \times \sqrt{3} \times 440} =$ 23.2 amps and the rotor phase and line current 55 amps.

The size of cables in this case should be based on the current carrying capacity, as the length of cable run is so short that the voltage drop will not be necessary to consider. Assuming that single core rubber insulated cables are used, reference to the latest I.E.E. table of current-carrying capacities of cables will show that for the stator 7/20's cable with capacity of 24 amps, and for the rotor 7/16's cable with capacity of 46 amps, will be satisfactory, the rotor cable will easily carry up to 55 amps for five minutes.

The second award (5s.) is made to "W. H." for the following:—

"A. C." does not give the number of poles on the motor in question, and it is therefore not possible to answer his queries definitely; neither does he state the slip-ring volts of the motor with full excitation voltage and rotor at a standstill, so it is impossible to give the rotor amps. However, assuming a 6-pole motor having a synchronous speed at 1,000 r.p.m., the following values would represent standard practice for a 10 h.p., 440-v., 3-phase, 50-cycle, slip-ring motor.

	Full load.	50% Overload.
Efficiency ...	80%	75%
Power factor ...	76%	80%
Stator amps. ...	16·2	24·6
Assumed rotor volts (standstill) ...	70	70
Rotor amps. ...	94	143

The value of the rotor volts assumed above is suitable for a 3-phase, star-connected rotor, and represents the voltage measured across the slip rings. It has also been assumed that 50 per cent. overload is overload horse-power, and not torque. Under these circumstances, the size of the motor for a 5-minute rating be limited by the overload capacity, and not by the heating on such a short time rating. If the rotor volts should be different from the assumed figures, the rotor amps should be changed in the inverse proportion.

A suitable cable for wiring the stator on a 50 per cent. basis (*i.e.* 24.6 amps for 5 minutes) would be 7/18, giving a current density of 2,000 amps per square inch. For the rotor, which apparently will be short circuited by the controller, the size of cable will be limited more by the voltage drop, the reason for this being that the slip of the induction motor depends upon the total resistance of rotor, brushes, and cables (including contacts). The cable, if run at a high density, may seriously increase the slip. A suitable size of cable would therefore be 37/15, giving approximately 1,000 amps per square inch density on 50 per cent. overload, and a C.R. drop of approximately 0·6 volt for a 15-yard out and back run.

Damage by Floods to Water-power Plants.—The extensive series of water-power generating stations of the Southern Power Co. in Carolina and other plants in the district supplying hundreds of cotton-mills, besides lighting and power to towns, were seriously affected by record floods about the middle of last month. According to the *Electrical World* (New York), five stations on the Catawla river were shut, aggregating 125,000 kw., by water covering the operating floors. A portion of the load was taken by steam stations. In one case the water rose 30 inches in the station, reaching the generators, but just not submerging the bearings, and the outdoor transforming stations were also damaged. The water washing about the concrete dams cut new channels which will have to be repaired. Extensive damage was also done to distribution systems, railways, and telegraph and telephone lines in the district by the floods and the hurricane which preceded them.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published August 10th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

10,752/15. **Controllers.** E. SCHATTNER, T. G. TRAVIS, and J. R. WALTON. A controller, specially applicable to motors for driving centrifugal mixers and similar apparatus where smooth deceleration is essential. In order to prevent re-establishment of the supply when once interrupted, before the speed of the motor has fallen to a sufficiently low value, a small solenoid is provided, energised by the back E.M.F. of the motor which holds up a catch preventing the starting arm from being moved from the off position until the back E.M.F. has been reduced to a certain value. (Three figures.)

11,263/15. **Transformers.** B.T.-H. Co. (*G.E. Co., U.S.A.*). A form of winding for transformers made up of a number of solid dished disc-shaped coils of closely wound conductors with a central ventilating space between the winding and the core, and further ventilating space between adjacent coils. (Two figures.)

16,407/15. **Submarine Signalling.** W. REDMAN. Apparatus for receiving or detecting submarine sounds comprising one or more chambers in communication with the exterior of the vessel, each chamber being divided at its inner end into two compartments, each containing an air chamber adapted to serve as an air lock, together with a diaphragm, one of the diaphragms being connected with a telephone transmitter in circuit with a receiver or relay. (Three figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: A. G. BROWN-BOVERI ET CIE [Insulators] 5,511/15.

Dynamos, Motors, and Transformers: MOND (*Maschinenfabrik Oerlikon*) [Ventilation of machines] 10,711/15; T. BROADBENT & SONS, B.T.-H. Co., and WISE [Control of motors driving hydro-extractors] 11,603/15; MASCHINENFABRIK OERLIKON [Braking crane motors, &c.] 17,419/15; S. KAWAKAMI [Motor pump] 1,526/15 (*100,056*).

Electrometallurgy and Electrochemistry: MARINO [Electro-deposition of tin] 11,011/15; SIEMENS & HALSKE A.G. [Electrolytic apparatus] 8,111/15 (*100,739*).

Ignition: KETTERING and CHRYST [Ignition systems] 7,758/15 and 5,841/16 (*100,361*); W. J. MELLERSH-JACKSON (*Champion Ignition Co.*) [Sparking plugs] 2,020/16 (*100,933*).

Storage Batteries: W. J. MELLERSH-JACKSON (*India Rubber Co.*) [Separators] 7,567/16 (*100,994*).

Switchgear, Fuses, and Fittings: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Pneumatically operated controllers] 11,658/15; WILKINSON [Electromagnetically operated switches] 12,379/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Protective devices] 12,747/15.

Traction: BACHELET ["Levitating" apparatus] 10,726/16.

Miscellaneous: WADE (*Leeson*) [Coil winding] 10,755/15; SIEMENS SCHUCKERTWERKE GES. [Connectors] 6,977/16 (*100,739*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Telegraphy and Telephony: AUTOMATIC TELEPHONE MANUFACTURING Co. [Automatic telephone systems] 7,100/16 (*100,941*); E. GIRARDEAU and J. BETHENOD [Spark gaps for wireless telegraphy] 10,095/16 (*100,957*); L. DE FOREST [Oscillating audions] 10,122/16 (*100,959*).

Miscellaneous: T. B. DIXON [Transforming motor into electrical waves or impulses] 2,524/16 (*100,940*) and 8,303/16 (*100,942*); ALLMANNA SVENSKA ELEKTRISKA AKTIEBOLAGET [Electric couplings] 9,745/16 (*100,948*); ELEKTROMEKANISKA AKTIEBOLAGET [Vacuum cleaners] 10,037/16 (*100,953*) and 10,038/16 (*100,954*).

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

18,160/02. **Revolving Stage.** O. STOLL. An electrically-driven revolving platform forming part of the stage with concentric sections capable of revolving at different speeds and in different directions.

18,328/02. **Electric Traction.** B.T.-H. Co (*G.E. Co., U.S.A.*) [Thermal maximum demand indicators] 9,851/07.

The following are the more important Patents that have become void through non-payment of renewal fees.

Switchgear, Fuses, and Fittings: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Thermal maximum demand indicators] 9,851/02.

Traction: W. L. BLISS [Train lighting] 8,929/02.

Miscellaneous: C. O. BASTIAN [Mercury vapour lamps] 9,718/04.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

The Electrical Contractor. By L. W. Moxey. 86 pp. 9¼ in. by 6 in. 15 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 6s. 3d. net.

IT may be some consolation to those who have struggled for many years in this country to raise the status of the electrical contracting industry by the introduction of more system and up-to-date methods generally to know that things are only just evolving into something like law and order in the States. That, at any rate, we gather to be the case from the author's preface. The book deals with office methods, estimating and calculating wire sizes for D.C. and A.C. currents, and illumination calculations, and also gives a large amount of general data accumulated in America during the past twenty years, but in spite of the American origin—or perhaps because of it—wiring contractors over here will find useful points in it.

Colour and its Applications. By M. Luckiesh. 357 pp. 9½ in. by 6¼ in. 129 figures, and 4 plates. (London: Constable & Co., Ltd.) 16s. net; abroad, 16s. 9d.

THE author is well known in the United States as one of the leaders of the new school of illuminating engineering that has carried out a deal of research work at the Nela Laboratory, National Lamp works of the General Electric Co. of America. He brings together information, opinions, and speculations on a number of branches of a subject, the better understanding of which would tend to improve the work of the engineer responsible for the carrying out of artificial lighting, and facilitate his co-operation with the artist. Besides theoretical considerations on colour and vision, there are chapters on its production, mixing, photometry, and photography, as well as its use in lighting, painting, and on the stage.

The Slide Rule. A Practical Manual. By C. N. Pickworth. 124 pp. 7¼ in. by 5 in. 39 figures. (Manchester: Emmott & Co., Ltd.) Fourteenth edition. 2s. net.; by post, 2s. 3d.

MR. PICKWORTH's well-known little manual on the slide rule needs no introduction to our readers. It has now reached its fourteenth edition, and an interesting new feature is a short section dealing with the solution of algebraic equations with the aid of the slide rule, a subject possibly capable of some development.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

The *Pall Mall Gazette* quotes the *New York World* in stating that the crowning achievement of wireless telephony has been a conversation between New York and Paris overheard at Honolulu. Mr. J. J. Carty, Chief Engineer of the American Telephone and Telegraph Co., is reported to have said, in true American vein:—"We use a conductor which connects up all creation. It is the ether. At a recent New York demonstration the music of the National Anthem went off into space with the velocity of light, and in forty-five years anyone who may be in the Pole Star may hear it."

THE BRITISH WESTINGHOUSE SUPPLY DEPARTMENT

ALTHOUGH the Supply Department of the British Westinghouse Electricity and Manufacturing Co. has only been established in its present home at Long Millgate, Manchester, for three years, it is already becoming generally well-known, if only for the large public clock which has been erected over the entrance. This clock consists of a copper housing supported on wrought-iron supports, with the name Westinghouse sawpierced over the top of the dials at each side, the dial and

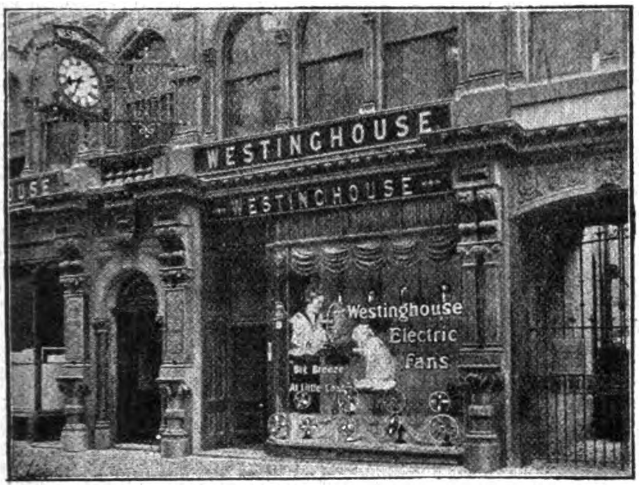

FIG. 1.—WESTINGHOUSE SHOWROOM.

backing to the sawpiercings being of white opal; the whole will, of course, be illuminated as soon as the lighting restrictions are removed, and will be seen from both ends of Long Millgate. This clock is one of four which are synchronised with, and receive half-minute impulses from, a master or controller clock situated in the showroom. This master clock, in its turn, will shortly receive the 10 a.m. time signal direct by wire from Greenwich Observatory.

Another attractive feature of the shop window at Long Millgate is a skeleton advertisement cut out from a "Cat" Fan poster and stuck on the inside of the glass, forming a very

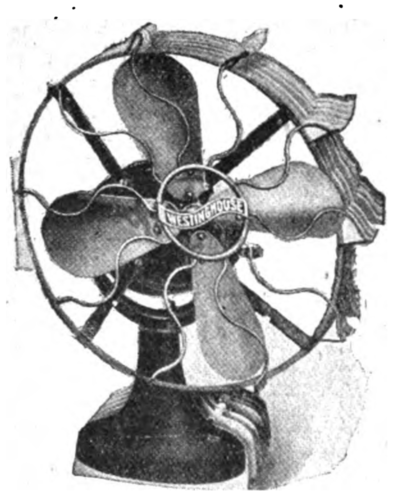

FIG. 2.—WESTINGHOUSE NOVELTY FAN.

striking advertisement. The window is set out with Westinghouse fans of different types and sizes, and incidentally with a novelty list and window-card combined. The latter is a special catalogue designed and devised by the Department, and takes the form of a Westinghouse fan stamped out to correct shape and printed in three colours to represent a fan; by means of a strut attached to the bottom of front cover, and fitting into a slot in back cover, this will stand on its own base as illustrated. This forms a very attractive and novel advertisement for electrical contractors, to whom it has been distributed.

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £124 to £128 (last week, £122 to £126).

LOCAL NOTES

Belfast: *Large Electricity Profits.*—There was a net profit of £17,492 on the working of the electricity undertaking last year, and it is proposed to transfer £5,000 to relief of rates.

Chesterfield: *Supply to Munitions Works.*—A private meeting of the Corporation has been held to discuss the financial position of the electricity undertaking having regard to the result of last year's working. The question of whether the charge for electricity to munitions works is sufficient to meet present costs is also being considered.

Dundee: *Reduced Supply last year.*—Owing to the restrictions upon public lighting and the general economy by private consumers, the lighting consumption last year was 11 per cent. less than in the previous twelve months. Fortunately, however, the demand for power purposes was larger than usual, so that the total decrease in the demand was only a little over 2 per cent. The figures for July this year show that a larger number of units was generated than in July last year.

Glasgow: *Electricity Accounts.*—There was a net surplus on the past year's working of the electricity undertaking of £5,317, which has been transferred to the credit of reserve fund, now standing at £55,897. The revenue account shows an increase of £124,347, of which £55,825 is attributable to the 15 per cent. added to consumers' accounts for the year. On the other hand, working expenses have increased by £104,133, principally due, apart from the greater output, to the much higher price paid for coal, the all-round advance in the cost of materials, increased rates and taxes, bonuses to workmen, and to the payment of £5,976 allowances to employees on active service. The average price received was 1·108d. per unit, against 1·074d. per unit in the previous twelve months. Although the contracts for coal for the coming year show an increase over last year's figure, the Committee do not propose to increase the 15 per cent. addition to accounts already in force. The number of units sold to private consumers was 110,489,622, an increase of about 29 per cent. The maximum demand was 45,880 kw. against 39,750 kw. in the previous twelve months, an increase of 15½ per cent. As a result of the opening of the show-room eight months ago, 1,400 kw. of apparatus has been installed. The tests with gas-producer plant at the Port Dundas station are still being continued, but an 8,000-h.p. steam turbine is on order for this station and another for the Pollokshaws Road, and it is anticipated that both sets will be in operation for next winter's load.

Greenock: *Large Profits.*—There was a net surplus of £7,000 on the electricity undertaking last year, after setting aside for depreciation £4,667. The revenue increased over the previous year by £22,945, and the result of the year's trading is that the reserve fund, with the £7,000 now available, is only £4,323 short of the maximum required by Act of Parliament. The number of units generated was 23,000,000, against 17,000,000 in the previous twelve months. Mr. F. H. Whysall, the engineer, and his staff have received the congratulations of the Electricity Committee.

Hove: *Small Electricity Profit.*—There was a surplus of £139 on the electricity undertaking last year, which the Committee regard as satisfactory, remembering the increase in the cost of coal and other materials. A discussion took place at the last meeting of the Council upon the accounts, during which it was suggested that a minimum of 10s. should be imposed upon private lighting consumers; but, although the accounts were passed, the question of imposing a minimum charge was referred to the Electricity Committee for consideration.

Stockton: *Bulk Supply.*—The Electricity Committee has found it possible to close down a further portion of the steam generating plant and to reduce the staff in consequence of the new arrangement with the Cleveland and Durham Electric Power Co.

Yarmouth: *Electricity Accounts.*—Although there was a trading profit of £2,353 on the electricity undertaking last year, to which is to be added £759 brought forward, capital charges amounting to £9,331 leave an adverse balance of £6,219. In order to bring the undertaking into a more sound financial position, the Council is recommended to increase the charge for lighting by 1d. per unit, and that for power by 10 per cent. A member of the Electricity Committee has suggested leaving the sinking fund payment for the year in abeyance, but no decision has been come to upon this point.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Ashton-under-Lyne.—The Chairman of the Electricity Committee and the Engineer are to wait on the Ministry of Munitions with regard to obtaining some new generating plant.

Barrow-in-Furness.—A loan of £3,955 is to be applied for in connection with supply to the Admiralty.

Burton.—An expenditure of £4,000 is to be incurred to give a supply to a new works for the India Rubber, Gutta Percha Telegraph Works Co., Ltd.

Rochdale.—The Electricity Department require twelve months' supply of static transformers. Borough Electrical Engineer.

Miscellaneous

Danish West Indies.—The United States Vice-Consul at St. Thomas, Danish West Indies, calls attention to a market for electrical supplies here, particularly moderately priced electric fans, which are almost unknown on the island. At present a number of hand-worked punkah fans are in use. It is recommended that correspondence should be in English.

Powell Duffryn Steam Coal Co.—The Powell Duffryn Steam Coal Co. require twelve months' supply of electrical goods. Further particulars from Stores Manager, Aberaman, and tenders to the Directors, 101 Leadenhall Street, London, E.C., by September 6th.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Metropolitan Electric Supply Co.—A statement of the company's accounts for the first six months of the years 1913, 1914, 1915, and 1916—being two pre-war and two war periods respectively—has been issued, showing that, except for a slight decrease in the first six months of 1915, there has been a steady increase in the number of units sold in each succeeding half-year. The increase is most marked in the last half-year (1916), notwithstanding the adverse effect produced upon the lighting load by the Daylight Saving Act and by the restrictive regulations under the Defence of the Realm Act, the figure being 11,600,918 units, or an increase of 2,064,227 units. The directors consider the half-year's trading satisfactory, especially as the costs of production have largely increased owing to the war, the price of coal, alone, being 50 per cent. higher than in 1914. The interim dividend of one shilling per share on the ordinary shares, already announced, will absorb £10,000, and leave an unappropriated balance of £25,368.

W. T. Henley's Telegraph Works Co.—An interim dividend at the rate of 10 per cent. per annum, less tax, for the June half-year is recommended on the ordinary shares.

Adnil Electric Co.—In the House of Commons on Thursday Mr. Hudson asked the President of the Board of Trade if he was aware that a winding-up order was made by the Courts on July 30th, 1915, nearly twelve months after war was declared, against the Adnil Electric Co., Ltd., the bulk of whose capital was of German origin, the company being practically the English branch of the Bergmann Co., of Berlin. He also asked in what position the creditors of British, neutral, and enemy countries stand as to priority of claim on the assets. Mr. Harcourt, speaking for the President of the Board of Trade, said the facts stated were correct, but the winding-up order was not made under the Trading with the Enemy Act, but under the ordinary law, consequently the claims of British, neutral, and enemy creditors ranked equally, but any amount due to an enemy creditor would be paid to the Board of Trade. In answer to a further question, Mr. Harcourt said he did not think it was desirable at present to extend to British and neutral creditors under an ordinary winding-up order the priority at present given in a winding-up under the Trading with the Enemy Act.

Electric Vehicle Charging.—With reference to the correspondence between the Clerk to the Rugby Urban District Council and the Electric Vehicle Committee (Electrical Engineering, August 10th, p. 301), we are now informed that the British Thomson-Houston Co. and Messrs. Willans & Robinson have promised to provide charging facilities for any electric vehicles passing through Rugby upon the following conditions:—1. During holiday periods no arrangements can be made for the charging of outside vehicles; (2) a charge of 2d. per unit will be made for all electric energy supplied for this purpose between 7.30 a.m. on Monday and 12 noon on Saturday; (3) at weekends an additional charge of 2s. per hour will be made for charging vehicles between 12 noon on Saturday and 7.30 a.m. on Monday; (4) it is understood that neither of the firms will accept any responsibility for loss or inconvenience that may be caused by their inability or failure to charge any vehicle or vehicles. It is advisable that any firm sending vehicles through Rugby, and requiring a charge at that place, should communicate, in advance, with either firm in order that the necessary arrangements may be made. The Electric Vehicle Committee expresses its indebtedness to the two firms in question for kindly making these arrangements.

Isaria, Ltd.—In an advertisement appearing in our last issue offering for sale the whole of the stock-in-trade of Isaria, Ltd., the name of Mr. Ernest Owers, who will conduct the sale, was, by a printer's error, given as Mr. Ernest Owens. The sale includes some 1,200 meters of various types, 750 electric fans, and quantities of current limiters, motors, dynamos, and electrical parts. Catalogues can be obtained from Messrs. Bolton, Pitt, and Breden, Incorporated Accountants, 140 Leadenhall Street, E.C., and of Mr. Ernest Owers, 200 Finchley Road, N.W. Further particulars appear in an advertisement on another page.

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SUMMARY

WE give some particulars of the damage done at the Dublin G.P.O. during the Irish Rebellion. Although the rebels took possession of the Office soon after noon on April 24th, and quickly expelled the staff, a circuit to London was joined up at an intermediate point within a couple of hours. The ingenuity with which the staff set about the task of keeping up communication with outside during the Rebellion is worthy of the fullest praise, as is the manner in which the restoration of permanent communication simultaneously with maintaining the temporary communications was put in hand (p. 320).

LONDON municipalities and companies within a radius of 20 miles of East Ham are conferring with a view to evolving a scheme for the unification of electric supply. An Engineers' Committee has been formed on which 15 companies, all the London Borough Councils, and 8 extra-Metropolitan Boroughs are represented (p. 321).

WE publish an article on induction motors for lift operation in which the author makes an analytical comparison of the characteristics of squirrel-cage and wound rotor motors, and shows that in some cases the high-resistance squirrel-cage rotor is preferable to the wound rotor (p. 322).

ALL the lock machinery of the New York State Barge Canal is to be electrically worked (p. 323).

OUR Questions and Answers page this week deals with the causes of rapid deterioration of the positive plates of accumulators, with the use of such accumulators during an emergency period, and with the cost of their repair (p. 324).

A COMMISSION has been appointed to consider the conversion to electric traction of the steam railways in Belgium after the war (p. 324).

AMONG the subjects of Specifications published last Thursday at the Patent Office were the ventilation of turbo-alternators, controllers for motors driving hydro-extractors, train control and braking of crane motors. Application has been made for the suspension of two more enemy-owned patents relating to the Thermit process of rail welding. A liquid starter patent is opposed. One of the Strowger automatic telephone patents expires this week after a full life of 14 years, together with others relating to multiple unit train working and quick-break switches (p. 325).

THE Hammersmith Council is to give a large supply to the Chiswick Electric Supply Corporation.—New private consumers have been refused a supply at Aldershot (p. 326).

AN expenditure of £27,000 on new plant is contemplated at Dundee; traction lamps, &c., are required at Portsmouth; telephones and other apparatus in Australia; mains, ducts, and transformers at Hammersmith; and 10,000 traction lamps at Johannesburg (p. 327).

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE.
ORDERS FOR AUGUST, 1916, BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Headquarters and Range.—The Headquarters will be closed during August, except on Tuesday evenings. The range will be open on Thursday evenings only. On these evenings the Sergeant-Major will take charge and be responsible for the maintenance of order and discipline. Recruits are urged to take advantage of this arrangement for drill and shooting.

Instruction Classes.—Instruction classes at Regency Street will be held as usual for Platoons Nos. 9 and 10.

Camp.—The Camp at Otford will be available until August 31st. Members wishing to attend should enter their names at Headquarters on the sheet provided for the purpose. The cost will be about 3s. per day. Members should provide themselves with 2 blankets, knife, fork, spoon, plate, mug, and a spare pair of boots.

Entrenching.—As many members as possible should endeavour to attend the Sunday Entrenching Parades, in order that the work to be done may be completed as expeditiously as possible. Parade in Uniform, as usual, at Victoria Station (S.E. & C. Rly.) Booking Office, 8.45 a.m. Members are reminded that this work is of national importance, and, therefore, all who are able to put in Saturdays and occasional week-days are urged to do so. They are reminded that they can obtain railway vouchers from the booking clerk by showing their cap badges.

Technical College Announcements, &c.—The South-Western Polytechnic (Manresa Road, Chelsea) will re-open on September 25th for day and evening classes. The engineering courses include lectures in electrical and mechanical engineering, physics, chemistry and mathematics, and practical instruction in the laboratories. Students are prepared by recognised teachers of the University of London for the B.Sc. Degree in Engineering, for the examinations at the Engineering Institutions, and of the City and Guilds of London Institute. The evening courses also include classes in electrical wiring and other trade subjects. In the Electric Wiring Department an advanced course has been arranged for the preparation of candidates for the Final Wiremen's Examination of the City and Guilds of London Institute. Arrangements have been made for placing students who have passed satisfactorily through the three years' day course in positions with large engineering firms, and hitherto such firms have offered more vacancies than the Institute has been able to fill with its students. The prospectus may be obtained on application to the Secretary (Room 23).

The Goldsmid Engineering Entrance Scholarship, of the value of £30 a year, tenable for three years, will be competed for at University College, London, in September. Full particulars of the Scholarship Examination can be obtained from the Secretary of the College, to whom application should be made before September 1st.

A Board of Scientific Societies.—The Royal Society has recently brought about the establishment of a Board of Scientific Societies for promoting the co-operation of those interested in pure or applied science; supplying a means by which the scientific opinion of the country may, on matters relating to science, industry and education, find effective expression; taking such action as may be necessary to promote the application of science to our industries and to the service of the nation; and discussing scientific questions in which international co-operation seems advisable. The Board at present consists of representatives of 27 scientific, including technical, societies. The regulations give power to add to this number and to appoint as members of sub-committees individuals who are not necessarily connected with any of the constituent societies. An executive committee has been appointed consisting of the following members:—Sir Joseph Thomson, O.M., P.R.S. (chairman), Dr. Dugald Clerk, F.R.S., Sir Robert Hadfield, F.R.S., Mr. A. D. Hall, F.R.S., Prof. Herbert Jackson (hon. secretary), Sir Alfred Keogh, K.C.B., Sir Ray Lankester, K.C.B., F.R.S., Prof. A. Schuster, Sec. R.S., Sir John Snell, Prof. E. H. Starling, F.R.S., Lord Sydenham, G.C.S.I., and Mr. R. Threlfall, F.R.S. The first meeting of the Board was held last month, the matter under discussion being the co-ordination of the work carried out at present by a number of independent bodies.

THE IRISH REBELLION

BY the courtesy of the *Post Office Electrical Engineers' Journal*, we are enabled to publish the photographs below and the following interesting particulars from an article by Mr. E. Gomersall (Superintending Engineer, Dublin), which appeared in the last issue of the above journal. As is known, the General Post Office was captured by the rebels, and this contained the trunk telephone exchange, as well as a very large telegraph instrument room. There were also eight dry-core cables of various sizes in the basement of the building, and a standard carrying some wires on the roof. The rebels took possession of the Post Office building on Easter Monday (April 24th), soon after noon, and quickly expelled the staff. Nevertheless, a circuit to London was joined up at an intermediate point within a couple of hours. The local exchange was not in the General Post Office building, but in Crown Alley, and this was not attacked until after the arrival of a military guard, which was requisitioned as soon as news had come in of the Post Office being seized.

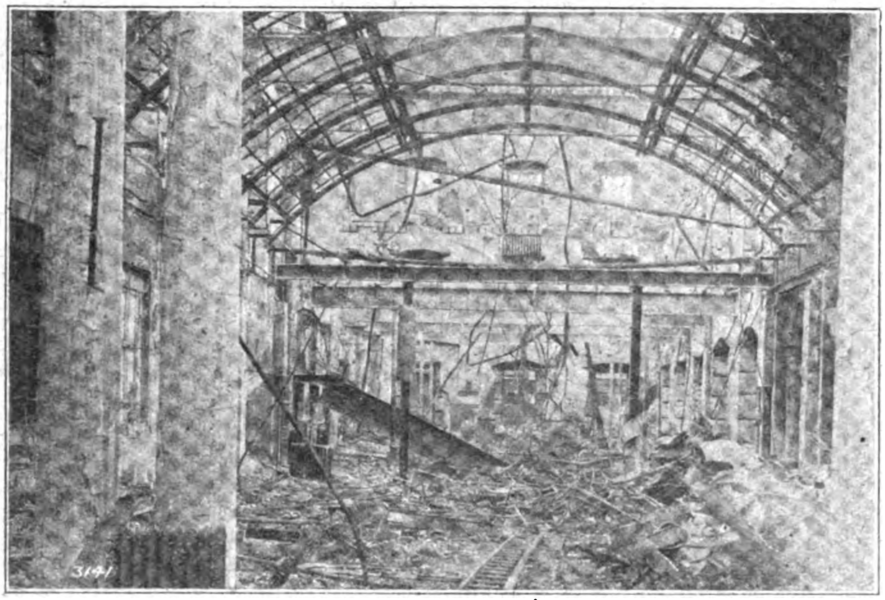


FIG. 1.—PUBLIC OFFICE, G.P.O., DUBLIN. THE RETURNED LETTER OFFICE AND TELEGRAPH INSTRUMENT ROOM WERE ABOVE IT. MAY 4TH, 1916.

Needless to say, the engineering staff passed through a very trying and dangerous ordeal. Telegraphic and trunk telephonic communication was essential, and new telephone circuits had to be provided for military purposes, and, in addition, the local telephone system had to be maintained. Many members of the staff could not leave the vicinity of their homes, and several of those who could were unable to reach their normal places of duty; but before midnight on Easter Monday supervising officers and men were concentrated at three points in the outskirts, including certain officers who had been despatched from Belfast immediately the fact of the rebellion was known there, and men were in attendance at the Dublin Exchange. These arrangements continued until Tuesday, May 2nd, after which it gradually became possible to operate without the same extreme risk.

On Easter Monday night, at 11 p.m., when trunk telephonic communication was urgently needed, several men were sent by motor-cycle and side-car, supplied by the Chief Engineer, Irish Command, to points several miles outside Dublin. After midnight they cut into one important circuit on very high poles, and succeeded in diverting it, by means of subscribers' circuits, into an exchange which happily was still in communication with the main exchange. The next morning, however, the main line was damaged by the rebels. Linemen who went after the fault were threatened by the rebels and fired upon. The military headquarters were informed of the locality in which the rebels were, and in the evening it was possible to make good the wires. On the next morning (Wednesday) the rebels cut down the line again some miles further away from Dublin. Other trunks were extended to the local exchange under similar conditions of danger and difficulty.

In the meantime, additional telegraph circuits were being joined up. During the fighting three temporary telegraph offices were installed at different points, and, in addition, cross-Channel wires were joined up at two other places. Telegraphic communication with Great Britain, and with all the most important places in Ireland, was thus restored, and it was maintained throughout the operations, although the wires were strictly reserved for military and official purposes. Simultaneously with the rising in Dublin the lines had also been cut down at a large number of other places.

A general idea of the damage which was done will be gained from the following statement :—

Nearly all the main lines in the vicinity of Dublin were cut, generally in two or three places. The method adopted was to chop down two or three, sometimes more, poles, and to cut the wires. At many places telegraph and telephone instruments were removed from the offices and smashed to pieces in the road; block and electric train staff instruments and telegraph and telephone apparatus in signal boxes were battered and destroyed. When the work of diverting the telegraph wires to a new office was begun it was discovered that the rebels had cut most of the underground telegraph and trunk telephone cables. Among the interesting cases mentioned in the article is the case of a bullet passing through a 75 ft. stout pole, 3 ft. above the ground, through the protection pipe, and lodging in the cable. The fault in this cable was not traced without difficulty! Two hundred and fifty subscribers' telephones and sixteen private branch exchanges were burnt out or disappeared in ruined buildings.

The provision of additional circuits for military purposes was a matter of much difficulty, and unusual methods had to be employed. It was necessary to commandeer a large number of subscribers 'circuits and extend them elsewhere, and in some cases, in order to obtain the material, line plant had to be taken down and apparatus removed from subscribers' premises. All the work was both difficult and dangerous—difficult inasmuch as it was necessary to find lines which were intact to replace others shot down, and dangerous because zones of fire had

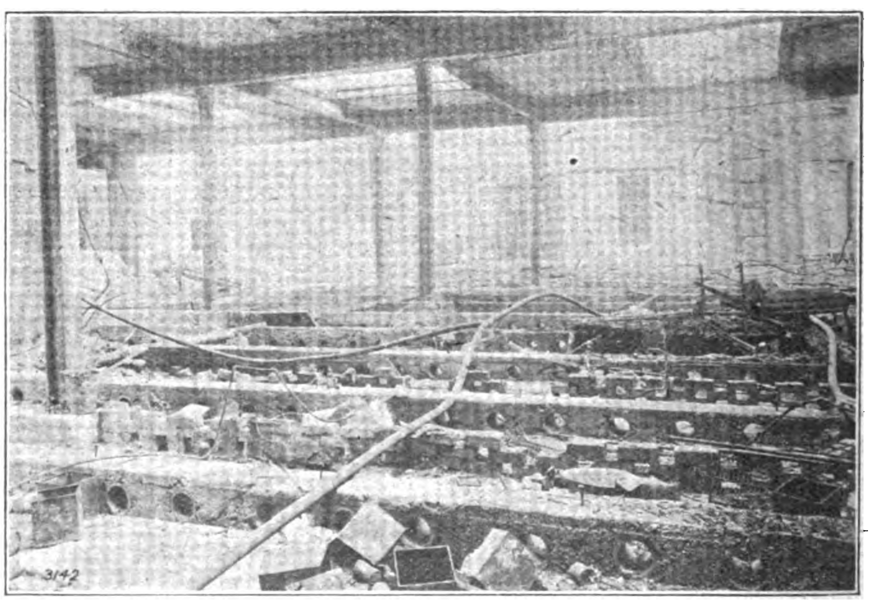


FIG. 2.—GENERAL SORTING OFFICE, DUBLIN.

to be crossed and the work had to be done where firing was in progress. Much of the firing was from house-tops. There were some narrow escapes. A lineman, cycling along a line after a fault, refused to turn back, and was fired upon, the bullet striking the front number plate of the machine. Another lineman carrying telegraph apparatus through a fire zone had a man shot dead a few yards from him. Two telegraph officers

who went to repair an important telephone rendered assistance to a dying man under fire, repaired the telephone, brought a doctor, priest, and ambulance, and returned safely.

Continuous attendance was given at the main exchange throughout the rebellion, and day and night attendance for periods at other exchanges. Some officers were continuously in attendance nine days. Cross connecting work, etc., in the test room at night had to be done with lights out. These officers now have also an expert knowledge how to put a building into a state of defence, and probably know the weight of a sand-bag with accuracy.

On Tuesday, May 2nd, it became possible to ascertain the extent of the damage, to approach the Post Office, and gradually to organise the work of restoration. The magnitude of the task was soon apparent. It was clear that a new telegraph office would have to be installed, and that this work would have to proceed simultaneously with the repair of cables and wires, the diversion of the wires to a new office, the diversion of trunk telephone circuits to the local exchange, and the restoration of the block signal and telegraph wires on the railways and of the damaged local telephone exchange circuits.

Only the shell of the Post Office remained, and in places the *débris* was still burning and the surrounding ground was extremely hot. When the Fire Brigade had cooled the *débris*, work was immediately started. On the following day it was decided that a new telegraph office should be installed on the upper floor of the parcel office at Amiens Street, pending the reconstruction of the G.P.O., and requisitions were sent by telegraph to the Engineer-in-Chief for the necessary apparatus. The construction of the tables by Board of Works carpenters was then begun in the parcel office. The first consignment of apparatus arrived on Friday evening, May 5th, and the new instrument room was brought into use on Tuesday, May 9th. Meanwhile, the smaller temporary telegraph offices had been kept working, but on Thursday, May 11th, all the wires had been diverted to the new instrument room.

With much difficulty, 160 of the 208 72-ampere-hour cells were recovered from the basement of the G.P.O.—they had been very hot and were full of *débris* from the ceiling, but they appeared to be usable. They were carted to Amiens Street and there cleaned and set up. Heavy gauge cable was recovered also, and temporary arrangements were made for charging the cells. Meanwhile, the construction of the tables, the fitting of the apparatus, the diversion of the cables (including the laying of two pipes across five pairs of rails and two railway platforms and drawing in new cables), the provision of phonogram lines, and the wiring of the instrument room proceeded night and day. Two thousand primary cells were set up on the galleries, as the secondary cells had not sufficient capacity and might not prove satisfactory.

The test-frame arrived on Sunday—it had gone astray and was found at the bottom of the hold of a ship.

Two new sets of 126-ampere-hour secondary cells were set up ten days later, and the primary batteries have been made spare. The lead-covered cables were carried on the under side of the galleries and fed down to the distribution cases on the tables. The spacing of the instruments and the method of wiring is from start to finish on standard lines for permanent work.

Some cable, one or two motors, a large number of radiators, some electric light distribution boxes, and some electric light fittings, conduit, etc., have been recovered, but otherwise the whole of the valuable plant which was installed in the G.P.O. has either disappeared or is recoverable only as scrap. The office of the Dublin West Sectional Engineer in Sackville Street was also totally destroyed.

"LINKING UP" IN LONDON

THAT the circular of the Board of Trade (Electrical Engineering, May 25, p. 187), urging electric supply authorities wherever possible to link up their undertakings in the dual interest of economy in coal consumption and avoiding unnecessary capital expenditure, has had good results has been shown by various references in our columns. London, of course, takes credit for having demonstrated the desirability of linking up, the first efforts in this direction having been made several years ago by the Poplar and Stepney Borough Councils. Since the Board of Trade circular an important scheme has been set afoot in Lancashire and Cheshire (Electrical Engineering, June 8, p. 207), and we are now able to give some information as to proposals for a similarly comprehensive scheme in London and the surrounding districts.

It should be mentioned that there is a permanent body, consisting of representatives of Metropolitan Borough Councils, known as the Conference of Metropolitan Borough Councils owning Electricity Works, with a Committee of Engineers, whose function it is from time to time to consider various matters affecting the interests of such undertakings. This conference met on July 21st, when it was resolved :—

"That the Conference of Metropolitan Borough Councils owning electricity undertakings authorises the Committee of Engineers to invite a technical representative of every electrical undertaking in Greater London area, whether owned by Local Authorities, Electricity Supply Companies, Railway Companies, or the London County Council, to attend future meetings of the Engineers' Committee to assist in preparing, as completely as possible, a report on linking up generating stations in Greater London area.

"That the area of the Conference's operations shall include the areas of such Local Authorities owning electricity supply undertakings as are within or cut by a circle having a radius of 20 miles, with its centre at East Ham Town Hall, including the Urban District of Watford, and that such Local Authorities be invited to appoint two representatives, together with their respective Town Clerks and Electrical Engineers, as members of the Conference.

"That the title of the Conference be amended to read as follows :— Conference of Local Authorities in Greater London owning Electricity Undertakings.' "

The Engineers' Committee referred to was appointed to consider taking immediate steps to link up the whole of the generating stations in Greater London area in order to comply with the request contained in the circular of the Board of Trade. Up to the present the following companies have appointed representatives to the Engineers' Committee :—

North Metropolitan.	London & South-Western Railway.
Charing Cross.	Kensington and Knightsbridge.
Brompton and Kensington.	Notting Hill.
Twickenham and Teddington.	Metropolitan.
London Electric.	Harrow.
City of London.	Richmond.
Great Eastern Railway.	
Chelsea.	
Hendon.	

Owing to the holidays, few of the local authorities have held meetings subsequent to the issue of the invitation to join the Conference, but up to the time of writing the following have complied, viz. : Ealing, East Ham, Bexley Heath, Leyton, Finchley, Barnes, Willesden, and Beckenham, whilst the Grays Council has signified its intention not to come in at present.

At a meeting of Metropolitan Municipal Authorities, held on March 26th, 1915, the following resolutions were adopted :—

"That in the opinion of this Committee, subject to the adoption of the following conditions, a Central Authority should be established to deal with the supply of electricity for London, viz. :—

"(1) The Central Authority shall include representatives of the London County Council and adequate representation of Borough Councils being authorised distributors.

"(2) No attempt shall be made by the Central Authority to hamper or restrict the economic development of any existing Borough Council generating station, and for this purpose all existing and future powers shall be conserved for the purpose of this clause. The London County Council shall sanction loans to the Borough Council on terms which shall not be more onerous than any it imposes upon any undertaking.

"(3) The purposes for which the Central Authority shall be established shall be :—

(*a*) The supply of electricity in bulk to authorised distributors.

(*b*) The supply of electricity for traction purposes.

(*c*) The standardisation of the London supply by a scheme and on terms to be jointly formulated by the County and Borough Councils.

"(4) The Central Authority shall not compete in distribution with the Borough Councils who are authorised distributors.

"(5) If the London County Council purchase the undertakings of the companies, it shall transfer to the various Borough Councils the distribution of electricity within each area.

"(6) Deficiency rate shall be levied on any Borough Council which does not take a supply under any scheme formulated by the Central Authority.

"(7) No attempt shall be made to purchase compulsorily any Borough Council undertaking, and no Borough Council shall be prejudiced by reason of its refusal to sell.

"(8) The provision of the London Electric Supply Acts (1908 and 1909) for closer co-operation between existing undertakings shall, with suitable safeguards, be made compulsory."

That is as far as the matter has been carried at present, so far as publication can be permitted. It will be seen that the object is to evolve a scheme on the lines of the above resolutions, and we can only express the hope that local and political jealousies will not once again stand in the way of a business-like solution of the problem of electric supply in London.

SQUIRREL-CAGE v. WOUND ROTOR MOTORS FOR LIFT OPERATION

For slow-speed passenger and goods lifts, with a speed of less than 250 ft. per minute, two kinds of induction motor are available—namely, the wound rotor machine and the squirrel-cage motor with a rotor of high enough resistance to cause it to give maximum torque at starting with high efficiency in starting current. The suitability of the latter for some types of lifts has not been generally recognised, but its superiority in certain cases is demonstrated in a contribution to the *General Electric Review* by Mr. R. H. McLain, who makes an analytical comparison of the characteristics of the two types of induction motor.

There are three vital factors concerned in applying a motor to a lift; first, the motor must have sufficient starting torque to always start the lift; second, there must be a good means of controlling the starting and stopping of the motor so as to make sufficiently accurate landings; third, the motors must not be overheated by the frequent recurrence of a typical duty cycle. The fundamental difference between a motor with a wound rotor and a squirrel-cage motor, as to starting torque, is that the wound rotor machine must be wound for a definite number of poles in the rotor, each of which produces a certain sector on it, whose magnetic path, under fully saturated conditions, is most favourable in one position only to a corresponding pole in the primary. The rotor pole and stator pole give their best starting torque results only when they are in this most favourable relative position, whereas the squirrel-cage rotor is not wound for any definite number of poles, and consequently produces as much starting torque in one rotor position as in another. This difference, caused by the position, does not exist when the wound rotor motor is exerting normal starting torque, because the local reactance of the secondary windings is not sufficient in this case to disturb the flux paths. A squirrel-cage motor of similar design in all respects except the rotor windings will exert more starting torque in any position than a wound rotor machine will exert in its most favourable position, because the whole periphery of the rotor is working without any distortion of its flux.

This difference may amount to something like 33 per cent. in favour of the squirrel-cage motor. Consequently, when built for the same maximum starting torque, a squirrel-cage motor can be built in a smaller frame than a slip-ring motor. The above difference of 33 per cent. in starting torque must be discounted about 10 per cent. on account of the full load running speed of the squirrel-cage motor being about 10 per cent. less than the wound rotor machine. The net difference when this is taken into account will be about 20 per cent. in favour of the squirrel-cage motor. Its rotor will be lighter, not only because of being smaller, but also because of the omission of extra weight of insulating material, slip-rings, connections between phases, &c.

The wound rotor unit is very much more flexible in regard to control than is the squirrel-cage motor, and for this reason has been used successfully on lift speeds as high as 250 ft. a minute. The squirrel-cage motor has been used successfully on speeds as high as 150 ft. a minute, but its most useful field is for speeds less than 100 ft. per minute. The wound rotor machine can be made to exert at starting a moderate torque which is suitable for starting a light load without too much of a jerk, and an instant later to exert a maximum torque which can be used, as the case may be, either for starting a heavier load, which failed to start on the first point of the controller, or for accelerating the light load. It is this feature of smooth starting which enables the wound rotor machine to operate lifts at as high as 250 ft. per minute without causing the operator an undue amount of trouble in making his landings. Furthermore, after a lift is installed, the starting and accelerating features of the wound rotor machine can be made either greater or less within certain limits so as to suit, in the best possible manner, the exact requirements of the lift as determined by trial. The squirrel-cage motor is not readily adaptable to any type of control which reduces its starting torque. It is most suitable for use when thrown directly on the line at starting. Consequently, it might jerk a light load unduly and will give the smoothest possible start only on full load. Practical experience has shown that this jerk does not become objectionable on speeds below 100 ft. per minute. Since the wound rotor is much heavier than the squirrel-cage, it will require a considerably heavier brake to stop it, and will cause considerably greater wear on the brake surfaces. Since the mass of the rotor and brake wheel are moved at so much greater speed than any other parts of these lifts, they are the only important things to be considered in connection with power for starting and brake wheel wear for stopping. The starting efficiency of the wound rotor unit will be considerably less than for the squirrel-cage rotor.

The proper relation of the starting torque to the running torque or "full-load" torque is determined actually by the characteristics of the gear efficiencies and only very slightly by the motor characteristics. Several tests made by the writer of this article, and tests recorded by others, indicate that many of these slow-speed hoists require, under maximum load, 200 per cent. as much torque to start the load as to hoist the load. The reasons for this excess torque requirement are that static friction of any two surfaces is greater than the running friction, and also, when worm gearing is used, the oil is squeezed from between the worm and the gear at standstill. The above relation of starting to running torque is not necessarily correct, and may be expected to vary from 150 per cent. on high-grade, high-speed lifts, such as usually require wound rotor units to 300 per cent, on low-grade, very slow-speed lifts, or lifts in a bad state of upkeep. In addition to the above facts, line voltage will frequently vary as much as 10 per cent., thereby causing a reduction in starting torque of 20 per cent. A very good rule to cover these variations in conditions, and one which practical experience seems to justify, is to make the starting torque 250 per cent. of the torque required to hoist maximum load. The motor should be able to exert this starting

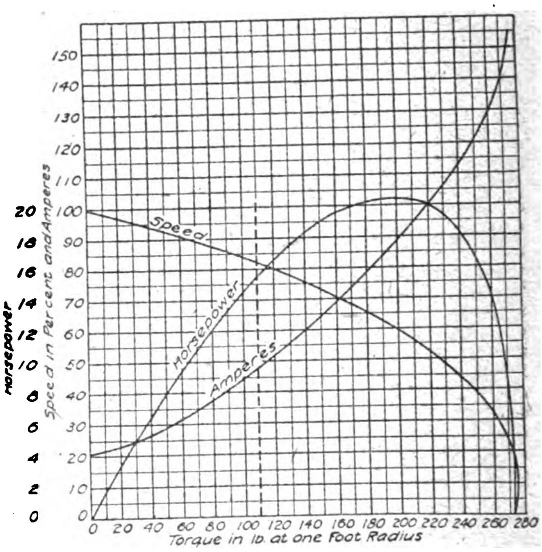


Fig. 1.

torque with the least possible disturbance to the line voltage consistent with good operating characteristics of the motor.

The starting amperes of an ordinary high-efficiency, low-resistance rotor, squirrel-cage motor, are entirely too high to be suitable for lift work. Such a squirrel-cage motor can be made suitable by increasing the internal rotor resistance sufficiently. The more resistance used, the more starting torque per ampere will be obtained, until a certain limit is reached, and for purposes of determining what amount of internal resistance is proper to use, two cases are considered. *First*, as in Fig. 1, which shows the speed-torque-current-horsepower curves of a certain motor, where the internal resistance is made just large enough to cause the motor to exert maximum torque at starting when the rotor is heated to the temperature which it would attain when run for one-half hour at 40 per cent. of this starting torque. *Second*, as in Fig. 2, which shows the speed torque-current-horsepower curves of the same motor with a new rotor having higher internal resistance just sufficient to cause it to exert the greatest starting torque per ampere.

At a running torque of 109 lb. in Fig. 1, we find the horse-power exerted to be 15·3. This motor will exert 273 lb. starting torque with 155 amperes, or 1·76 lb. per ampere. It will exert 15·3 h.p. running with 155 amperes starting current, or 0·99 h.p. per starting ampere. In Fig. 2 at a running torque of 60 lb., the horse-power is 6·67. This motor will exert 2·34 lb. starting torque per starting ampere, and it will exert 1·04 running horse-power per starting ampere. At first glance it would seem that Fig. 2 makes a superior motor because it exerts more torque per ampere at starting than Fig. 1, in the ratio of 2·34 : 1·76. However, this is not true at all, because if a 15·3 h.p. motor is required, and a motor with rotor designed as in Fig. 2 were used, it would have to be larger than the motor in Fig. 1, in the ratio of 15·3 : 6·67, and if its power-factor and other char-

acteristics were identical to the characteristics shown in Fig. 2, this motor would require $\frac{0.99}{1.04} \times 155$, or $147\frac{1}{2}$ amperes to start the load. However, in such a large motor, the power-factor conditions would be worse, because more iron and more air gap would have to be magnetised. A greater flywheel would have to be started. The first cost of the motor would be greater. Furthermore, the slip of this motor would be 35 per cent., as compared to a slip of 18 per cent. in Fig. 1, thus giving much poorer speed regulation and poorer running efficiency; consequently, a feature of design which might seem advantageous is really disadvantageous in all respects.

The conclusions reached would be altered if full load torque were considered to be any other than 40 per cent. of starting torque. A small value for full load torque would allow the motor in Fig. 2 to appear more favourably; and a larger value, less favourably. Consequently it is of some importance to decide in each installation the relation of starting to full load running torque. These fundamental facts of design can be entirely lost sight of if these motors are designed primarily to meet some central station rules and regulations which have been enforced up to the present time, rather than to meet the fundamental conditions of service.

One of the main objects of the article is to point out some of the fallacies which might be encountered in drawing up specifications for these motors. First: The method of testing for starting torque and starting current should be clearly understood. As pointed out above, Fig. 1 is made on the basis of keeping the temperature of the rotor the same as would be caused by a full load heat run for one-half hour throughout the whole length of the speed torque curve, and this curve shows that 273 lb. are obtained at starting with an expenditure of 155 amperes. Great care must be exerted on the test floor to keep from deceiving oneself in regard to the starting amperes. If this motor were connected to full voltage and kept at

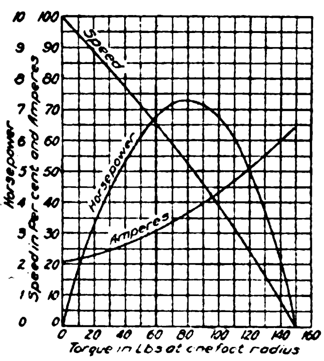


FIG. 2.

standstill, it would require only about seven seconds for the rotor to attain an extra temperature rise of 60 deg. C. under which conditions the motor would exert 268 lb. with 135 amperes. Fig. 1 shows $\frac{273}{155}$ or 1·76 lb. per ampere. However, with the rotor hot the motor would exert $\frac{268}{135}$ or 1·99 lb. per ampere. This merely goes to show that an apparent improvement of $\frac{1.99}{1.76}$ or 13 per cent., could be shown by using improper testing methods. The only accurate way to test one of these motors is to determine by several trials the exact starting torque which it will exert, and lock it against a spring balance whose reading will be this value of torque. Then allow the motor to cool down to operating temperature, and then take a reading of starting current, by means of an oscillograph, when it is suddenly connected to full voltage. This method is impractical for commercial purposes, and might better be supplanted by calculated results based on actual impedance and core loss tests, and checked by starting tests made at reduced voltage, under which conditions the heating of the rotor is insufficient to greatly modify accurate results.

Another suggestion for testing is to determine by several tests the starting torque of the motor. These tests can be made fairly well regardless of temperature, because starting torque does not vary so much with temperature as does starting current. Then determine the starting current by taking the reading of a dead-beat ammeter in the line when the motor is suddenly connected to full voltage, and allowed to start under no-load conditions. The reading of the dead-beat ammeter would not be the true instantaneous starting current of the motor, but it would be a measure of the disturbance which the motor would produce on the lighting system. Under this method of testing, a motor, having a very light rotor, would start up much quicker than a motor with a heavy rotor, and consequently would cause a smaller swing on the dead-beat ammeter. This is as it should be, and shows the advantage of a motor which has the proper characteristics.

Second: It will not do to specify that the starting current should be, for example, 200 per cent. of full load current. This specification is not clear in the first place as to what constitutes full load, and on this account may be entirely misleading. In the second place, a motor with a very poor and undesirable power-factor would meet this specification, and be inferior to a motor with a good power-factor and efficiency which did not meet it. A numerical example of this would be a bad motor, whose full load current was 50 amperes, and starting current 100, as compared with a good motor, whose full load amperes would be 30 and starting 90. Each motor might exert the same starting torque in pounds, yet the good motor would fail to meet the specifications.

Third: It will not do to specify that starting torque per ampere shall be some definite value, because this would lead to a motor having the poor characteristics already pointed out when comparing Figs. 1 and 2, and would not enable a given lift guaranteed for a certain speed in feet per minute, under full load conditions, to be started with as small a current as otherwise would be obtained.

Fourth: Having eliminated several of the undesirable methods of specifying and describing these motors, the author proposes that these motors be specified to have the greatest running horse-power (the running horse-power being that which corresponds to 40 per cent. of starting torque) per starting ampere. This specification encourages an endeavour to make a good, efficient motor, and also ensures that the greatest number of pounds can be hoisted in a lift at a specified speed with the least current demand from the line.

AN ELECTRICALLY EQUIPPED CANAL

THE new Barge Canal of New York State, which, when completed, will amount to 790 miles of waterway (including 350 miles of intervening lakes and rivers), with 57 locks, will have all its lock machinery, &c., worked by electric power. A few particulars of the equipment can be gathered from the *New York Times*. All the machinery used to work gates, valves, and capstans is electrically driven. Power is supplied at 250 volts, continuous current, from a power-house at each lock, except in a few cases where the locks are very near each other, and one power-station is made to serve two locks. The power-stations are heated by electricity and the locks are lighted by arc lamps.

Current is generated, for the most part, by the waste water of the canal. The only A.C. station is at the Crescent Dam, near Waterford, which supplies a series of five locks and two guard gates. Power is transmitted at 2,200 volts, three-phases, forty cycles, to sub-stations at Locks 3 and 5, where two 35-kw. induction motor-generator sets supply continuous current for working the lock motors.

In most cases the generators are of the vertical shaft type, 50 kw. or 75 kw., 250 volts, with speeds from 155 r.p.m. to 660, depending on the head. Horizontal shaft generators geared to hydraulic turbines are used in a few stations where the turbine speed is slow, due to low head. Where movable dams are used, the power is supplied by two 25-kw. petrol-driven sets, as there is no head when the dams are raised. Similar sets are used also at three other locks where the head is too small for a turbine installation.

The lock gates are of the swing type. The upper gate motors and, for the most part, the lower gate motors, are 7 h.p., excepting in a few cases, where 10-h.p. motors are used. In the control system there is a geared type limit switch, which automatically shuts off power when the gate is in full open or full closed position. This limit switch also controls the signal lights. As all the gate machinery is also arranged for hand working, an electric interlock is provided, which opens the control circuit when the clutch coupling dividing the hand can prove the motor is disconnected. The control of the valves is similar to the gate control, and is performed from a master switch, making use of a limit switch and electric interlock, as in the case of the gates.

At each lock there are two electric capstans, one at each end, for pulling the boats through. The motors are of special design, made watertight because of their being installed in a recess in the lock walls where water is present at times. They are 20 h.p., 550 r.p.m., 230 volt compound wound machines. The control is similar to the gate and valve control, except that the master switch is foot operated. Pressing down on the foot pedal with the toe starts the motor up one step at a time, the resistance being so designed that the motor may run continuously on any step. In this way the speed of the boat through the lock may be nicely regulated. Pressing the foot pedal with the heel throws the master switch back to the starting position and stops the motor. This type of capstan is used at all the locks except two, where the capstan

is operated by a 20 h.p., 650 r.p.m., 230 volt mill type motor, installed with the gate and valve motors in concrete cabins.

After the season of navigation is ended, the gates forming the movable dam are lifted up and suspended under the bridge, each dam being provided with two electric winches for raising the gates. Each winch is driven by a 12-h.p. compound wound motor. The motor not only raises and lowers the gates, but through a clutch and gearing moves the car back and forth across the bridge. Guard gates are used at several points along the canal, where it is necessary to protect lower portions from a flood such as would occur in case of a break on a lower lock.

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

QUESTION No. 1,508.

State the relative volts and amperes that can be obtained from a given interpole, self-excited dynamo, having wave-wound armature when run (*a*) as a continuous-current generator; (*b*) as an alternator; (*c*) as 50 per cent. C.C. and 50 per cent. A.C. generator. For alternating current give figures alternatively for two and for three slip rings. What is the relative heating obtained, and what special magnetic and electrical considerations must be observed, beyond those arising in ordinary direct-current design?—Koil.

(*Replies must be received not later than first post, Thursday, Aug. 31st.*)

ANSWERS TO No. 1,506.

I have just had to take charge of a battery of 58 cells used for lighting purposes, and find that although the battery is still being used, the majority of the positive plates have broken and dropped to the bottom. I know that the battery was in excellent condition eighteen months ago, after four years of service. What is likely to be the cause of such sudden and rapid deterioration? Are the negative plates liable to be damaged by using the battery in its present condition during an emergency period? What proportion will the cost of new positive plates bear to the original cost of the cells?

R. R.

The first award (10s.) is made to "M. M." for the following reply:—

Secondary cells of a reliable make should, if properly used, keep in good condition for eight or ten years. Evidently the battery mentioned in the question has either been badly treated or is of inferior manufacture. It is common experience that once cells begin to give trouble they quickly deteriorate; faults must be immediately located and corrected. One of the first signs of decay is a falling off in the capacity. Cells will often charge all right and give satisfactory tests, but careful measurements show that they have a reduced capacity. Therefore the cells, relatively, have to work harder, and the rate of deterioration is accelerated. In diagnosing the condition of a battery it is usually impossible to find out how it has been treated. Naturally, those responsible blame the cells, and it is very difficult indeed to determine with any certainty the real cause of the trouble.

The negative plates are likely to be indirectly affected owing to the heavier work following loss of capacity; also, in the present state of the cells, some of the plates may be short-circuited by pieces from the positives. With a cell completely run down trouble invariably follows. To get the best out of the battery, go over all the cells, and with a slip of wood make sure plates are not touching. Remove broken pieces, if at all possible. Give a good charge, and on discharge cut out those cells not up to proper voltage. General directions are to test cells for specific gravity of the electrolyte; this is all very well in the case of a battery when the engineer knows its history, but for this test to be of much use a lot of experience is necessary in the case of an old set of cells. However, all the points, such as colour of plates, gassing, &c., must be noted, and deductions made from general appearance and behaviour. Provided a low efficiency will be tolerated, a lot of work may yet be obtained from the battery.

A new set of positive plates will cost about 30 per cent. of the original price of the cells. When considering renewal of plates, it is often the better policy to have new negatives as well as positives, have fresh electrolyte, and start with practically a new battery. Patching up a set of cells is rarely satisfactory.

An issue of Electrical Engineering could easily be filled with directions for the care of a secondary battery. Main points are: Charge regularly and intelligently; never drop below 1·9 volts per cell; "top" cells with distilled water; keep accumulator house clean and well ventilated.

The second award (5s.) is given to "F. P. S." for the following:—

The positive plates of a cell are much more liable to break down than the negative, and, therefore, first show signs of bad usage. The principal causes of this are as follows:—(1) A too rapid discharge, which may, in extreme cases, amount to a short circuit; (2) charging at too high a rate, and this, as well as the too rapid discharge, may be aided by serious vibration; (3) wrong strength of acid in the cell.

From the data given, it seems clear that the battery has been badly treated during the last 18 months, as otherwise the defects would have shown themselves during the first four years. It is quite safe to use the battery, as the diminished area of the positive plates cannot affect the negative otherwise than by protecting them, owing to the reduced capacity of the battery. The only result of using the battery will be to increase the breakage of the positive plates, as now a smaller area has to do the work that formerly was done by the whole plate.

The pre-war cost of new plates would have been about 20 per cent. of the cost of the battery, but this figure should now be increased by 25 per cent., making the cost about 40 per cent. The cost of installing would be about that of the original cost of assembling, but the old plates have some little value as scrap.

ELECTRIC TRACTION NOTES

The future of the railways of Belgium is receiving attention at the hands of the Belgian administration, who are undertaking to put into working order the hundreds of locomotives which were withdrawn into France before the German occupation. It is said that a special commission has been appointed to consider the question of replacing steam traction by electrical working on all the main lines.

There was a net profit of £26,353 on the Wolverhampton Corporation Tramways undertaking (Lorain surface contact system) for the year to March 31st, 1916. After meeting capital charges, adding £5,141 to renewals, allocating £1,685 to additions and improvements, and £2,477 to cost of repair work carried out in 1916-17, and postponed from the previous year, the balance of £4,018 is transferred to relief of rates.

The programme for the annual meeting of the Municipal Tramways Association which, as we have already stated, will be held in London on Thursday and Friday, September 21st and 22nd, will be the Presidential Address, followed by two Papers: (1) "Some Notes on Passenger Transportation in Large Cities," by J. M. McElroy, general manager of the Manchester Tramways; (2) "Utilisation of Tramways for Goods Traffic," by Messrs. G. W. Holford, general manager, Salford, and W. Clough, general manager, Bury.

The Llandudno Electric Railway, Ltd., has consented to meet representatives of the Corporation in London at an early date with a view to discussing the price to be paid for current. The Council is losing heavily on the present agreement, and the object of the conference is to consider a fresh agreement based on the existing costs of production.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published August 17th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

10,711/15. **Ventilation of Turbo-alternators.** A. MOND (*Maschinenfabrik Oerlikon*). A ventilating system for cylindrical rotors of turbo-alternators, in which the air passes axially through slots intermediate to the winding slots from both ends simultaneously towards the centre, and is discharged in a radial direction. The ventilating slots are of a depth approximately equal to that of the winding slots, giving rise to increased magnetic saturation of the rotor teeth and producing a strong curvature of the load characteristic. They are provided with radiating wings near the ends of the rotor, which also act as fan blades. (Five figures.)

11,603/15. **Motor Control.** T. BROADBENT & SONS, B.T.-H. Co., and W. L. WISE. A controller for motors driving such machinery as hydro-extractors, which only run for a predetermined limited time. The circuit is opened automatically when the time has elapsed by the action of a descending weight working in conjunction with a dash-pot. (Four figures.)

11,658/15. **Electric Traction.** B.T.-H. Co. (*G.E. Co., U.S.A.*). A train control system in which the separate contactors are actuated in correct sequence by a cam shaft worked electro-pneumatically by a master controller. (Three figures.)

17,419/15. **Electric Braking.** MASCHINENFABRIK OERLIKON. A device for braking A.C. induction motors of the slip-ring type, driving cranes, hoists, &c., during lowering. The stator winding is excited by D.C. from an independent dynamo coupled to the hoisting gear, and driven during the descent of the load. (Four figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: C. J. BEAVER and E. A. CLAREMONT [Cable protection] 3,707/16 (*100,978*).

Dynamos, Motors, and Transformers: B.T.-H. Co. and WHITAKER [Starting and synchronising] 11,321/15; RAILING and GARRARD [Rotary converters] 13,934/15.

Heating and Cooking: KERR [Heater] 8,537/15.

Ignition: CONNER [Magnetos] 14,993/15; IRELAND [Sparking arrangements] 15,873/15; HEATH [Sparking plugs] 17,910/15.

Storage Batteries: VANDERVELL [Sealing of accumulator cases] 12,075/15.

Telephony and Telegraphy: LIDDLE (*Universal High Power Telephone Co.*) [Telephone transmitters] 11,976/15; E. A. PETITHORY [Telephone instruments] 5,061/16 (*100,987*).

Miscellaneous: BING [Magnetic clutches] 15,690/14.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Instruments: A. E. G. [Meters] 10,750/16 (*101,036*).

Telephony: WESTERN ELECTRIC Co. [Automatic call distribution] 10,611/16 (*101,033*).

Traction: BROWN, BOVERI ET CIE. [Multiple control] 10,099/16 (*101,023*).

Miscellaneous: C. F. KETTERING [Regulators] 6,404/16 (*101,014*).

Application for the Suspension of Enemy Owned Patents

788/06 and 926/06. **Rail Welding.** R. GOLDSCHMIDT. Applications by W. B. Ballantine respecting these patents, both of which deal with Thermit welding, will be heard on August 24th.

Opposition to Grant of Patent

6,340/15. **Motor Starters.** T. H. WOOLISCROFT. Opposition has been entered to a grant on this application. The specification describes an improved design of drum-type liquid starter.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

18,747/02. **Automatic Telephones.** R. HADDAN (*Strowger Automatic Telephone Exchange*). A complete system of automatic working for large telephone exchanges.

18,817/02. **Electric Traction.** B. T.-H. Co (*W. O. Mundy*) and 18,821/02 B. T.-H. Co. (*F. E. Case*). Details of connections, &c., of master controllers and reversers for multiple unit train working.

18,872/02. **Switches.** H. W. COX. A design of quick-break switch.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: H. BECK [Flame carbons] 10,513/07.

Incandescent Lamps: B. T.-H. Co. (*G.E. Co., U.S.A.*) [Machine for making filament supports] 10,021/06.

Switchgear, Fuses and Fittings: O. C. REGNART [Candle lamps] 10,119/04; C. W. DAWSON [Reflectors] 27,659/08.

Telephony and Telegraphy: S. G. BROWN [Loaded duplex telegraph lines] 10,073/04.

Traction: H. REID and D. M. RAMSAY [Turbo-electric locomotives] 10,311/04; A. E. G. [A.C. track boosters] 10,452/07.

Miscellaneous: BRUSH ELECTRICAL ENGINEERING Co. [Quartz lamps] 10,409/09.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Arithmetic for Engineers. By C. B. Clapham. 436 pp. 8¾ in. by 5½ in. 149 figures. (London: Chapman and Hall, Ltd.) 5s. 6d. net; abroad 6s.

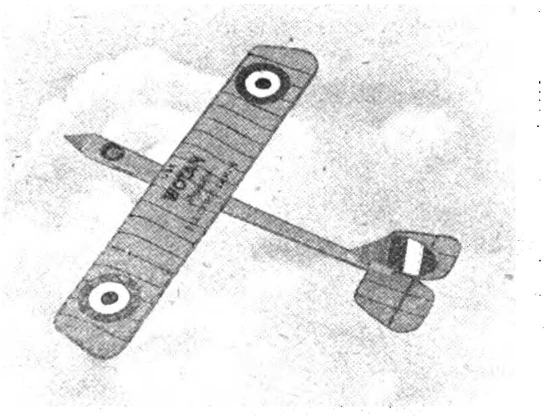
THIS book forms one of the series edited by Wilfred J. Lineham, and styled the D.U. (directly-useful) technical series. The author treats the elementary portions of what is usually called "practical mathematics." The book is not a mere collection of problems, as some previous books written specially for engineers have been, but its object is to teach arithmetic in a practical manner that will be directly useful to engineering students. It is profusely illustrated and should be specially valuable in junior technical schools and works trades schools, as well as to draughtsmen and apprentices who need a good book for private study. The chapter on "Symbols and their Uses," in which algebra is introduced, is excellent, as also are the very practical examples given throughout the book.

Killed in Action.—It is with the deepest regret that we record the death in France on August 1st, from wounds received on July 30th, of Lieut. H. A. Chamen, Bedfordshire Regiment, age 22, younger son of Mr. W. A. Chamen, Engineer and General Manager of the South Wales Electrical Power Distribution Co. Lieut. Chamen, before the outbreak of the war, was a student at Reading University College, in the Agricultural Department. He was a member of the Officers Training Corps throughout. On the outbreak of war he volunteered for service, and after a month's special training in camp at the Queen's University, Belfast, was gazetted to the South Wales Borderers as Second Lieutenant. After two or three months, however, he decided to make the Army his permanent profession, and proceeded to the Royal Military College, Sandhurst, from which he was given a commission in the Bedfordshire Regiment, and went out to France in May, 1915. He came home accidentally wounded at the end of July, 1915, but returned to France in January, 1916. He was in the heavy fighting at Trones Wood on July 12th and 13th, and came through without injury, but in an attack on the German positions south of Guillemont on July 30th his battalion was heavily shelled, and young Chamen was badly wounded by a shell. He died from his wounds on August 1st, and was buried at Corbie, near Amiens.

War Tribunals.—The accountant and editorial assistant of the Institution of Electrical Engineers have been granted four months' exemption by the Westminster Tribunal.—The Blackpool Tribunal has granted exemption until the end of the season to twelve motor men, one contract supervisor, and a skilled mechanic in the employ of the Corporation Tramways Department. Mr. Furness, the Borough Electrical Engineer and Tramways Manager, said that if these men had not been exempted, fifteen or eighteen cars would have had to be withdrawn from service.

THE "WOTAN" AEROPLANE MODEL

MESSRS. SIEMENS BROTHERS DYNAMO WORKS, LTD., of 38-39 Upper Thames Street, E.C., are now issuing for trade distribution an ingenious advertising device. This is known as the Wotan Monoplane Model, and our illustration is an actual photograph of the made-up model in flight. It is accurately balanced, and when launched in the manner of an ordinary glider, is capable of performing many of the evolutions of a power-driven aeroplane. The component parts of the model are printed in colours on a sheet of paper of special quality. These have to be cut out as directed, and when bent and stuck together can be easily assembled. The size of the completed model is 10½ in. across the wing tip, and the length from nose to tail is a little over 9 in. By adjustment of the tail elevators it is possible to make the model loop the loop, or complete a spiral descent. The instructions give the various adjustments required for the different manœuvres. For instance, if the tail elevator is set horizontally the model will fly a good distance in a straight line before coming to earth.



If the tail elevator is slightly turned down the model travels downwards at a direct angle. If the tail elevator is turned upwards the model lifts in flight.

At the present time, with the great interest taken in aviation there should be a lively demand for this novelty, which will be supplied free to users of electric lamps. The making-up of the model is not an arduous occupation, and can easily be accomplished during the evenings. An open space is, of course, the best place in which to make flights, although this is possible in any fair-sized room, but care should be taken that the model does not break itself against obstructions.

The various members of the trade who are interested in the sale of Wotan lamps should take an early opportunity of communicating with Messrs. Siemens Brothers Dynamo Works, Ltd., asking for a supply of these sheets for distribution amongst their lamp-purchasing customers. We also understand that a number of complete made-up models are available for trade display, so that the actual model can be exhibited in a contractor's window. It is, of course, understood that these advertisements are supplied free, and must therefore not be sold.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"The Slide Rule: A Practical Manual." By C. N. Pickworth. 124 pp. 7¼ in. by 5 in. 39 figures. (Manchester: Emmott & Co., Ltd.) Fourteenth edition. 2s. net; by post, 2s. 3d.

"A Treatise on the Theory of Alternating Currents." By A. Russell. Vol. II. 566 pp. 8¾ in. by 5½ in. 239 figures. (Cambridge: The University Press.) Second edition. 15s. net; abroad, 15s. 9d.

"Color and its Applications." By M. Luckiesh. 357 pp. 9¼ in. by 6¼ in. 129 figures and 4 plates. (London: Constable & Co., Ltd.) 16s. net; abroad, 16s. 9d.

"Principles of Electrical Design: D.C. and A.C. Generators." By A. Still. 365 pp. 9¼ in. by 6¼ in. 146 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 12s. 6d. net.

LOCAL NOTES

Aberdeen: *Increased Output.*—There was an increase of 20 per cent. in the total output last year, due to the large demand for power, heating, and cooking. Over 2,000 h.p. of new motors have been added to the mains during the past twelve months.

Aldershot: *New Consumers Refused.*—The Lighting Committee has received a number of applications for supply from private consumers, but the reply has been given that the present is an inopportune time to carry out such extensions. There was considerable criticism of this view at the last meeting of the Council, and an amendment in favour of the applicants being connected to the mains was put to the vote, but was lost.

Dartford: *Deficit on the Electricity Undertaking.*—There was a deficit of £3,845 upon the working of the electricity undertaking last year.

Hove: *Depreciation.*—The Chairman of the Electric Lighting Committee has suggested the desirability of setting aside £2,000 or £3,000 per annum in respect of depreciation on the plant of the electrical undertaking, in addition, of course, to the capital charges. As the undertaking at present, owing to the war, is making only a very small profit, it is difficult to see where the money is to come from, unless a call is made upon the rates for this purpose. It is doubtful whether this principle will be adopted by the Corporation, at any rate, during the war, unless the undertaking is able to show sufficient profits to justify a special depreciation fund.

London: *Hammersmith: Supply to Chiswick Company.*—The Electricity Committee has received an application from the Chiswick Electricity Supply Corporation for a supply of electrical energy to enable them to give an additional supply to a large munitions factory. About 450 h.p. will be required by the middle of October, and the Borough Electrical Engineer has reported that the estimated cost of the necessary cables, including ducts and transformers, will be £3,300. The revenue is estimated at £3,500 per annum, and the Electricity Committee recommend that the supply be given on the following terms: (*a*) The Corporation to agree to take a supply of electricity for the munition factory referred to within their area of supply, the minimum guaranteed payment for the supply to be £2,000 per annum. (*b*) The price to be charged to the Corporation for current supplied to be at the rate now agreed upon. (*c*) The Corporation, or the proposed consumers, to advance to the Borough Council the capital sum required for laying on the supply, viz., £3,500, or thereabouts, the Council to pay to the Corporation or the proposed consumers interest at the rate of 5 per cent. per annum upon the said sum of £3,500 or the actual capital sum advanced as the case may be in respect of each and every year in which the actual consumption of electrical energy exceeds in value £2,000. (*d*) The cable and apparatus to remain the property of the Council, and to be taken over by the Council as soon as may be after the termination of the contract for supply, at the agreed price of £2,000.

Malvern: *Electricity Profits.*—The working of the electricity undertaking last year showed a net profit of £698, which the Electricity Committee considers satisfactory, having regard to all the circumstances.

Newport (Mon.): *Honorarium to Electrical Engineer.*—The Corporation recently spent some time discussing a proposal by the Board of Management of the Newport National Shell Factory that Mr. A. Nichols Moore, the Borough Electrical Engineer, should take charge of the electrical plant in the factory and supervise its maintenance, and that he should be granted an honorarium for this work. Some members of the Corporation objected to the honorarium being paid at all, whilst others suggested that it should be deducted from Mr. Moore's salary. Eventually the matter was referred back to the Electric Lighting Committee.

Perth: *Electricity Accounts.*—After meeting capital charges there was a net profit of £284 on the working of the electricity undertaking last year, of which £200 is to be placed to reserve, and the balance carried forward. The reserve fund now stands at £4,481, or nearly 75 per cent. of the total allowed by Act of Parliament. An increase of 12½ per cent. is to be made in the charges for current for lighting and 5 per cent. in the power rates.

Plymouth: *Coal Costs.*—The recent permission of the Board of Trade to the South Wales coalowners to charge 2s. 6d. per ton more than the 4s. per ton allowed by the Coal Price

Limitation Act, would mean a further £1,900 per annum in the cost of coal for the electricity undertaking. At the last meeting of the Electricity Committee a member stated that if the price of coal continued to increase in this way, it would be cheaper to rebuild the electricity works where water-power could be used.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Dundee.—The Electricity Committee recommend application being made for a loan of £27,000 for new plant. There is at present unexpended borrowing powers of £17,825, to the use of which, however, the Committee is already pledged for prospective works. The £27,000 is required for new applications and anticipated developments in the near future.

London: *Hammersmith.*—Mains, ducts, and transformers are required at an estimated cost of £3,300 for giving supply to the Chiswick Electric Supply Corporation.

Miscellaneous

Australia.—The Commonwealth Postmaster-General's Department require tenders for accumulator batteries at the City Telephone Exchange, Sydney. Copies of specifications may be consulted at 73 Basinghall Street, E.C.

The Victorian Government Railway Commissioners require 100 electric time-releasing mechanisms with two normal and two reverse contacts, and 50 with four normal and four reverse contacts. The specification may be consulted at 73 Basinghall Street, E.C. Tenders by October 18th. This information is, of course, only of use to firms who can cable agents.

British manufacturers can see, at 72, Victoria Street, S.W., or 73, Basinghall Street, E.C., specifications and tender forms in connection with the recent calls for tenders by the Adelaide Deputy Postmaster-General for telephones, telephone materials, instruments, and parts.

Edmonton.—The Guardians require six months' supply of electric lamps. Clerk, September 20th.

Portsmouth.—The Tramways Department requires six months' supply of insulating materials, lamps, motor windings, and overhead line materials. General Manager, August 29th.

South Africa.—The Johannesburg Council require 10,000 drawn-wire metal filament traction lamps, and 10 miles of 19/14 insulated wire for outdoor use. September 4th.

The Council also require a supply of tramcar spares. September 21st.

Copies of the specifications, &c., may be consulted at 73 Basinghall Street, E.C. This information is, of course, only of use to firms who can cable agents.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Leek.—In connection with the scheme for reconstructing the gas plant at the electricity works (Electrical Engineering, July 6, p. 263), the Council has accepted a tender by Messrs. Crossley Bros. for gas producer plant and gas engine at £2,465 and a Mather & Platt dynamo at £773. Application is to be made to the Board of Trade and Ministry of Munitions for permission to have this work put in hand by the makers. There was some opposition by some members of the Council to continuing with gas plant, but eventually the Committee's scheme as above was accepted.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. Geo. Smith and Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £126 to £128 (last week £124 to £128).

Sale of the E.P.S. Millwall Works.—Owing to the completion of the extensions to the works of Pritchett & Gold and Electrical Power Storage Co., Ltd., at Dagenham Dock, the works at Millwall, formerly the works of the Electrical Power Storage Co., Ltd., have been closed. It is not without interest to note that this is the closing of what is, we think, the oldest electrical works in this country. The Millwall works were opened by the Electrical Power Storage Co. in 1881, and have been continuously occupied in the manufacture of storage batteries during the last 35 years. All communications previously addressed to Millwall should now be addressed to Dagenham Dock, Romford, Essex.

Ozonair Prices.—Owing to the cost of all materials, metals, and labour, in addition to the ordinary cost of production, having risen, Ozonair, Ltd. (96, Victoria Street, London, S.W.), are unavoidably compelled to increase their prices. All listed goods will be increased by 15 per cent., keeping the discounts the same. In like manner, all estimates which have been priced net will be increased by the same amount, namely, 15 per cent. This increase of price will date from the 20th August, with the exception that all orders which have been posted before the 20th will be accepted at the old price. This increase is not intended to be a permanent one, and the hope is expressed that it will be possible to revert to ordinary list prices before very long.

Liquidations.—A first and final dividend of 10s. in the £ will be paid on August 30th at 6 Clement's Lane, London, E.C., in the liquidation of the Adnil Electric Co., Ltd.

Plant for Sale.—The Bradford Electricity Department has for sale a Willans' two-crank compound engine, coupled to a 300 kilowatt 500 to 550 volts Phœnix multipolar generator: also a 250-cell storage battery, with the exception of woodwork and copper connections. Further particulars from Town Clerk, to whom offers should be sent by September 5th.

APPOINTMENTS AND PERSONAL NOTES

The West Ham Corporation requires a Manager for their electric tramway system at a salary of £600 per annum, rising by £50 increments to £750. Applications to Town Clerk by August 31st.

Mr. W. Fraser, Station Superintendent at the Barking Urban District Council's electricity works, has been appointed to take charge of the electrical plant in important shell and projectile factories under the Ministry of Munitions.

The Heywood Corporation Electricity Department requires an electrical engineer with experience of extra high-tension bulk supply plant and E.H.T. mains, as well as the commercial management of an electricity undertaking. Salary, £200 per annum. Applications to Town Clerk by August 28th.

Second-Lieut. A. J. Pearson, Machine Gun Section, who has been awarded the Military Cross, was engaged with the Western Electric Co. as telephone engineer in their engineering department.

CATALOGUES, PAMPHLETS, &c., RECEIVED

MOTORS.—A leaflet, No. 3 (Catalogue No. 5), from T. W. Broadbent, Ltd. (Victoria Electrical Works, East Parade, Huddersfield), gives full specifications, price lists, shipping weights, etc., of their M type motor. This motor is made in three forms: protected, having the live and working parts protected by end shields; ventilated, which is similar to the protected excepting that the inspection holes at the commutator end are fitted with ventilated doors, whilst at the driving end ventilated covers are fixed; and total enclosed, in which, as its name implies, the doors and covers are solid and completely enclose the live and working parts.

British Westinghouse War Fund.—We understand that 2,100 employees of the British Westinghouse Co. (Manchester) have joined the Forces, and that a total of £27,906 has been contributed by the employees and company for the assistance of those with the Colours and their dependents.

Ediswan Change of Name.—The Edison & Swan United Electric Light Co., Ltd. (Ponder's End, Middlesex), has changed its name to "Edison Swan Electric Co., Ltd."

TRADES DIRECTORY OF
ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
Fletcher (H. J.) & Co., Bridge Works, New North Rd., London, N.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sloog, H., 51, Anson Rd., London, N.W.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
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Union Cable Co., Ltd., Dagenham Dock, Essex.

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COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

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Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
The Bastian Elect. Heating Syndicate. Ltd., 185, Wardour St., W.C.

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Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Record Electrical Co., Ltd., Caxton House, Westminster. S.W.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
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British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
"Lamlok," 18, Ranelagh Gdns., Hammersmith, W.
London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
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Underfeed Stoker Co., Ltd., Coventry House, South Place, E.C.

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Bastian Meter Co., Ltd., Kentish Town, N.W.
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General Electric Co., Ltd., 67, Queen Victoria St., E.C.

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Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

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Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
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Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Electric Control, Ltd., 177, Reid St., Bridgeton, Glasgow.
Ellison (George), Warstone Lane, Birmingham.
Ferguson, Pailin & Co., Ltd., Hr. Openshaw, Manchester.
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Gent & Co., Ltd., Faraday Works, Leicester.
Graham (Alfred) & Co., St. Andrew's Works, Crofton Park, S.
Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd. 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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SUMMARY

An interesting Canadian water-power station is described on page 330.

Some particulars of the cables used on the L. & N. W. Railway electric traction scheme are given (p. 330).

The use of a battery on A.C. distribution service at a sub-station of the Edison Electric Illuminating Co., of Boston, U.S.A., is described, and the means adopted for maintaining normal frequency and voltage during discharge are indicated (p. 331).

One switchboard attendant was killed and another was injured at an electric power station in an outlying district of London during last Friday's air raid (p. 332).

The output of electrical machinery in the United States increased by practically 50 per cent. between 1909 and 1914. A recent census of production shows that the totals in the two years were £48,007,496 and £71,882,534 respectively (p. 332).

An inexpensive method of improving the power factor of a group of squirrel-cage induction motors when running on light load is described in our Questions and Answers columns this week (p. 333).

Among the subjects of specifications published last Thursday at the Patent Office were the starting of rotary converters, telephone transmitters, and cable protection. A patent for inductive loading of duplex telephone lines has been granted in spite of opposition. Licences have been granted under two enemy-owned patents relating to electrolytic production of metals. A patent for a "dead man's handle" for traction controllers expires this week after a life of 14 years (p. 334).

There is the possibility of tramway undertakings in India experiencing, for the first time, competition from motor omnibuses (p. 334).

The 65,000 kw. continuous-current power plant of the Ford works at Detroit is peculiar, not only in its size for a D.C. system, but in that the generators are driven by steam and gas engine cylinders acting on the same crankshaft (p. 335).

We publish some notes on recent tendencies in the design and construction of turbo-generators (p. 336).

Street lighting with half-watt lamps is to take the place of arc lighting in Dublin.—Women labour has been resorted to for cable-laying at Bo'ness (p. 336).

1st LONDON ENGINEER VOLUNTEERS

Headquarters, Chester House, Eccleston Place.

Orders for September, 1916, by Lt.-Col. C. B. Clay, V.D., Commanding.

General Parade.—A General Parade will be held on Saturday, Sept. 30th, at 2.45, at Headquarters. Uniform.

Lectures.—W. Eyles, Esq. (late R.E.) has kindly consented to give four lectures as follows:—

Wednesdays, Sept. 6th and 13th, "Bridging."
Wednesdays, Sept. 20th and 27th, "Demolitions."

Members are requested to take special note that, during this month, the lectures will be on *Wednesdays* in place of Tuesdays.

Drills.—Drills will be held under the Sergeant-Major on Tuesday evenings, as during August.

Musketry.—The Range will be open on Thursday evenings, as during August.

Instruction Classes.—Instruction Classes at Regency Street will be held as usual for Platoons Nos. 9 and 10.

Entrenching.—Every Sunday at Victoria Station (S.E. & C. Ry.) Booking Office, 8.45 a.m. Uniform, haversacks, and water-bottles. Midday rations to be carried. The importance of a steady continuance of this work cannot be over-estimated. It has been pointed out by Major-General Dickie that the work is best done by moderate working parties *every* Sunday. "Half the number on consecutive Sundays is much better than double the number every other Sunday."

The Commandant desires to draw attention to the Report on Work Done on South London Defences in July, 1916, in which the paragraph referring to the Corps says: "The work has been very well done, and the task completed," and to express his gratification at the support he has received.

A *précis* of this Report, and the General Order recently issued is posted at Headquarters.

Otford Camp.—A most successful Camp was held during the early part of August, and some 20 men are still under canvas.

Special Note.—Ordinary Drills will be resumed on and after Sept. 18th. Supplemntary Orders will be issued later.

Corps Meeting.—A General Meeting will, if possible, be held at the end of September.

A CANADIAN WATER POWER STATION

A NEW water-power scheme established by the Laurentian Power Co. at Seven Falls on the St. Anne River, Quebec, drawing water from a large drainage area in the Laurentian mountains is described in the Canadian *Electrical News*. The local conditions are particularly favourable for an ample and steady flow and a high fall has been rendered available.

Above the falls, between the intake and the generating station, a distance of 3,098 feet measured along the conduit, the water is conducted by 1,677 feet of flow pipe terminating in a standpipe 16 feet in diameter and 79 feet in height and 1,421 feet of pressure penstock. From the intake the grade for the first 1,050 feet is 0.66 per cent., the remainder is set to a grade of 4.93 per cent. The station has a normal full load rating of 18,720 kv.a. generated by four units of 4,680 kv.a. each, with an overload rating of 25 per cent. for two hours. Three complete units are at present installed; the turbine for the fourth unit is in place, the generator and its bank of transformers to be installed later. Each unit consists of a horizontal, 6,000 b.h.p. Allis-Chalmers (Milwaukee), single discharge, single Francis runner, set in a cast steel spiral casing, operating under a normal effective head of 410 feet at a speed of 630 r.p.m., connected by solid flanged coupling to a 4,680 kv.a., 6,600 volt, 63 cycle, 3 phase, revolving field Canadian General Electric generator which is provided with a solid cast steel rotor, water-cooled bearings and provision for ventilation by solid cast steel rings with fan blades in one piece securely bolted to the cast steel spider of the rotor. The total weight of the complete generator is 140,000 lb., the weight of the revolving field and shaft being 60,000 lb., giving a flywheel effect of 200,000 feet pounds without recourse to any auxiliary flywheel. These machines have been given a runaway speed test of 1,200 r.p.m. for one hour at the factory before shipment, and are guaranteed to withstand short circuit current for one minute at any load.

The generator voltage is raised to 50,000 volts by banks of three single phase, 1,566 kv.a., oil insulated, water-cooled Canadian Westinghouse transformers delta connected on high and low tension sides. Duplicate exciter sets, each of sufficient capacity for the excitation of the four main units, are installed, consisting of Canadian General Electric, 130 kw., 125 volt, 900 r.p.m. interpole generators, water wheel driven by Canadian Allis-Chalmers impulse wheels with provision for motor drive.

Of the five bays dividing the station, four contain the main units with their corresponding bank of raising transformers, above which a gallery extends for the operating of the 50,000 volt disconnecting transformer switches, the roof of which supports the 50,000 bus-bars extending the full length of the station, supported on suspension insulators. The centre bay contains the exciter sets, floor space for dismantling a unit, back of which is located the 6,600 volt bus-bar structure and circuit breakers, the local service transformers and the main generator field rheostats. Above the main floor in this bay is the operating gallery containing the benchboard, exciter and local service switchboard, and the 6,600 volt bus-bar tie switch, and on another gallery above the operating gallery is located the 60,000 volt line and bus tie circuit breakers, and on the roof directly above is housed the electrolytic lightning arresters directly in line with the transmission lines.

The station may be operated with two units on one transmission line as two separate stations, complete flexibility and interchange being provided in the switching equipment. During the past few months the plant has been operating in parallel with the existing plants of the Quebec Railway, Light, Heat, and Power Company. The three wires of each circuit are composed of No. 1/0, seven strand, hard drawn copper cable, the centre strand being soft drawn. The cables are arranged in a vertical plane on each side of the tower, supported on 66,000 volt pin type insulators. Above each circuit is a $\frac{3}{8}$-in. galvanised stranded ground wire, supported on channel cross arms, similar to those used for the line conductors. The vertical spacing between all wires is 4 ft. 6 in., and the horizontal spacing between circuits is 8 ft.

Corrosion Tests.—At the last meeting of the Institute of Metals, Mr. J. Christie, the Borough Electrical Engineer at Brighton, gave an account of tests, which he had made as representative of the Institution of Electrical Engineers on the Corrosion Committee of the Institute of Metals, with a view to counteracting the effect of corrosion in his condenser tubes. It is interesting in this connection to note that the large scale experimental work of the Corrosion Research Committee of the Institute of Metals is now to be carried out at Brighton, thanks to facilities accorded by Mr. Christie at the Southwick power-station.

A LARGE CABLE CONTRACT

IN connection with the conversion to electric traction of the suburban lines of the London and North-Western Railway, we have now some further particulars of the large cable contract, forming an important part of the work, which was given to W. T. Henley's Telegraph Works Co., Ltd. This firm was responsible for the supplying and laying of the whole of the low-tension feeder cables, as well as all the jumper, sectioning, and cross-bonding cables. The total length of these heavy cables amounted to 20 miles, and Messrs. Henley's engineers have been on the site for nearly two years, the work having been very considerably delayed owing to the war. In addition to these cables, the firm also supplied and fixed 12 double-feed switch pillars with 2 s.p. 1,500 ampere switches, 22 section double-feed switch pillars, 76 section cross-bond, double-feed switch pillars, also 4 resistance pillars with 1,500 amp. s.p. switch and resistance grid to carry 3,000 amp. for 20-second periods at 10-minute intervals. The cables laid for the Euston to Watford electrification include the sections Willesden to Camden Town, Willesden to Acton Wells Junction, Chalk Farm to Loudoun Road, Chalk Farm to Broad Street, Acton Wells to Kew East Junction (London and South-Western Railway), Kew East Junction to Kew Bridge, and Acton Junction to Gunnersbury (London and South-Western Railway).

BATTERY USED ON A.C. DISTRIBUTION SERVICE

An interesting application of a battery to supplement A.C. distribution service has been worked out by the Edison Electric Illuminating Co., of Boston, U.S.A., for its Newton (Mass.) sub-station, and has been described in the *Electrical World* by Mr. J. Lester Woodbridge.

This sub-station is fed from the L street power-house of the Boston Edison Co., and receives energy at 13,800 volts, three-phase, 60 cycles, over duplicate transmission lines, the transmission distance being 12 miles. Several high-tension tie lines also extend from this sub-station to other sub-stations supplying adjoining districts. The sub-station supplies three classes of service—namely, (1) the local alternating-current commercial load of lighting and power, which is supplied to the distribution feeders at 2,300/4,000 volts, four-wire, three-phase; (2) direct-current series arc lights for street lighting; and (3) 575-volt direct current for operating the suburban electric railway in the district.

This sub-station was chosen for the first installation of this character partly because of the importance of the district served and partly because the existing apparatus in the sub-station was adapted for the purpose with but little change. The original arrangement of the apparatus is shown in Fig. 1 in full lines, while the apparatus added in connection with the battery installation is shown in dotted lines. The diagram is conventional, and shows only one phase of the three-phase circuits and one side of the direct-current railway circuit. Duplicate high-tension busbars were provided, and duplicate oil switches for each incoming and outgoing circuit permit each circuit to be connected at will to either set of busbars.

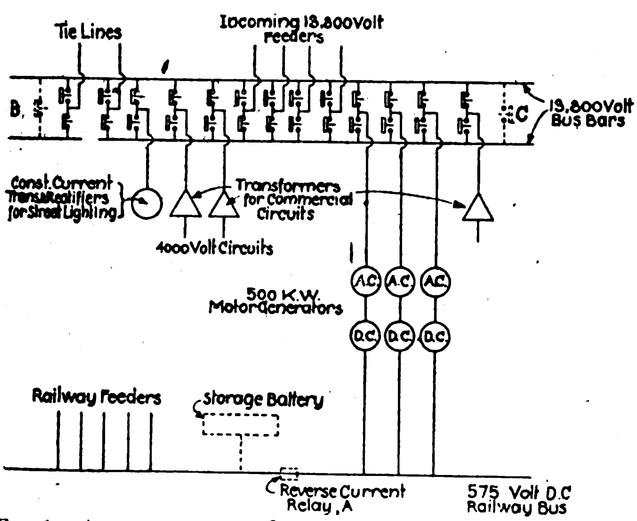

Fig. 1.—Arrangements of Substation Apparatus and Circuits. Broken Lines indicate Apparatus added with Battery.

Step-down transformers furnish the 2,300/4,000-volt current for the local commercial load, constant-current "tub" transformers with mercury arc rectifiers are used for the street lighting, and three 500-kw. motor-generator sets furnish the 575-volt direct current to the railway busbars. Each of these units consists of a 13,800-volt synchronous motor directly connected to a 575-volt interpole d.c. generator.

The problem presented was to install a battery to float on the railway busbars, but so arranged as to provide a reserve source of power for the local A.C. distribution circuits in case of any interruption in supply from the main power-station by feeding its energy through the motor-generator sets into the alternating current circuit. It was necessary to arrange this apparatus so that in case of trouble the battery would take up the local A.C. load without interruption, but would not feed into the entire high-tension distribution system through the 13,800-volt feeders. It was necessary that the battery should take up the local load automatically, and without even the briefest interruption, and it was also important to maintain the frequency and voltage on the local distribution circuit as nearly normal as possible without attention on the part of the operators. In order to accomplish these results, it was decided to use one of the duplicate alternating-current busbars for interconnecting all of the incoming high-tension feeders and outgoing tie lines, while to the other set of busbars would be connected all of the local distribution circuits, including the motor generators which supply the railway load. It will be noted that one of the high-tension busbars is divided into two sections, and this one was chosen for connection to the incoming high-tension feeders and tie lines. Two new oil switches, *B* and *C* in Fig. 1, were installed for connecting the distribution busbars to the busbars connected to the high-tension feeders. Normally, therefore, the entire current supply from the main power-house is received on one set of busbars and transmitted through either or both of the oil switches *B* and *C* to the other set for local distribution. The opening of the two oil switches *B* and *C*

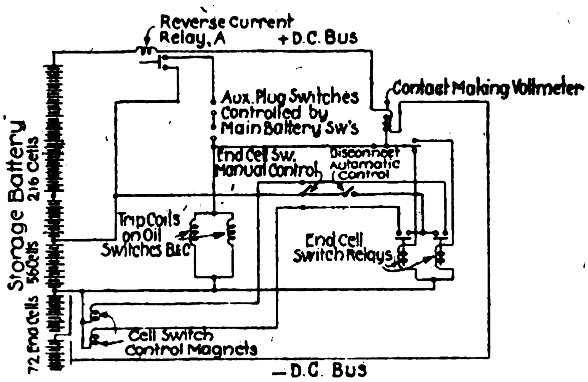

Fig. 2.—Automatic-control Circuits.

will, therefore, completely separate the high-tension distribution system from the local supply circuits, including the railway circuit.

An "Exide" storage battery of 344 cells, having a capacity of 2,250 amp. for one hour or 4,650 amp. for twenty minutes, designed to float across the 575-volt railway busbars, has been installed. This battery is connected to the railway busbars between the terminals of the motor-generator sets and the outgoing railway feeders, and reverse-current relay *A* is installed in the direct-current circuit between the battery and the motor-generator sets. Upon reversal of current between the battery and the generators of sufficient magnitude, due to any trouble on the high-tension circuits, this relay closes a contact which trips the two oil switches *B* and *C*, thus opening up the connection between the high-tension feeders and the local distribution circuits, leaving the battery connected to the latter through the motor-generator sets.

After this general arrangement of apparatus had been decided upon, it remained to provide for maintaining normal frequency and voltage on the alternating-current circuit during an emergency discharge from the battery. The local alternating-current distribution feeders are provided with feeder regulators of the induction type, automatically operated by contact-making voltmeters, and these are relied upon to control the voltage of the distribution circuits. To maintain normal frequency was a more serious problem, the frequency depending upon the voltage of the battery and the characteristics of the motor-generator sets when running inverted.

In order to insure constant voltage during an emergency discharge the battery is provided with motor-operated end-cell switches automatically controlled by a contact-making voltmeter connected across the battery terminals. This contact-making voltmeter closes, selectively, the exciting circuits of two relays arranged to operate the end-cell switches, one for either direction of travel, so that when the direct-current bus voltage is high cells will be cut out, and when the voltage is

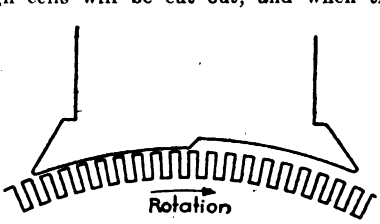

Fig. 3.—Re-designed Pole Shoe of Motor Generator at Direct-current End.

low cells will be added until normal voltage is restored. The exciting circuit of these two relays is, however, normally open, but is closed by the operation of the reverse-current relay *A* at the same time that the latter trips the oil switches *B* and *C*. Fig. 2 shows the arrangement of these control circuits. There are seventy-two cells of the battery connected as end cells, three cells between adjacent points of the cell switches, and in order to avoid the use of an end-cell switch with twenty-five points, two cell switches, each provided with thirteen points, were installed.

Having thus provided for the maintenance of constant voltage during an emergency discharge, the only remaining point to be

determined was the characteristic of the motor-generator sets when running inverted. The direct-current generators of these machines were designed to give practically constant voltage from no load to full load, with a decidedly drooping characteristic on overloads, thus protecting the machines by relieving them of a part of any excessive load when the substation is operating in parallel with adjacent substations. This characteristic was secured by so designing the machine that a distortion of the field flux due to armature reaction on overload would produce saturation in the trailing pole tip and in the teeth under this pole tip, thus reducing the total magnetic flux and the resulting voltage. It was found that this design gave quite undesirable characteristics to the machines when operated inverted. Two of these machines when thus operated in parallel would become unstable at less than half load, even when running as shunt machines with the series field entirely cut out, and the slightest unbalance would cause one machine to take off all the load, and reverse the other machine until the circuit-breakers would open.

A study of the design of the machines showed that this result was due to the same effects of armature reaction and saturation which produced the drooping characteristic on overload when operating direct. To overcome this difficulty the pole pieces of the machine were re-designed by introducing a step in the middle of the pole face to produce a sudden change in the length of the air-gap, as illustrated in Fig. 3. The length of air-gap was thus reduced on the leading side and lengthened on the trailing side. At no load and normal excitation the armature teeth and pole tips on the leading side would thus become saturated owing to the distortion of the field flux on the side of the short air-gap. The effect of armature reaction when the machine is operating direct is to restore a more uniform distribution of field flux by shifting the flux toward the trailing pole tip and weakening the field under the leading tip. As this continues, the effects of saturation under the leading tip disappear, and the weakening effect of armature reaction on the field strength becomes more pronounced, thus maintaining the original drooping characteristic on overloads. When running inverted, however, the effect of armature reaction is reversed, tending still further to strengthen the field under the leading tip and still further to weaken the trailing tip. The new design was such that the effect of saturation under the leading tip was about equal to the effect of the long air-gap under the trailing tip, and the resulting effect of armature reaction on the total flux was practically negligible. These new pole pieces were applied first to one of the machines for test, and, this proving satisfactory, the other two machines were thus equipped. The resulting speed-load characteristic when running inverted was practically a straight line for all loads.

In order to secure still further stability, one turn of series field was added inside of the equaliser connection, connected to oppose the original series field, so as to act cumulatively when the machine is running inverted. The effect of this inside series field on the normal voltage characteristic of the machine was counterbalanced by removing the shunt from the outside series field, and a final adjustment was made by partially shunting the inside series field. As a result of these changes, the machines continue to operate as before when running direct, while the effect of suddenly inverting the machines when running in parallel is to divide the load equally between them with no tendency to instability.

During normal operation, therefore, the battery is floating directly across the railway busbars, which are maintained at a substantially constant voltage, so that the battery is doing no work. In case of any trouble on the high-tension distribution system of sufficient magnitude to cause the battery to take up all of the railway load, and actually feed back through the motor-generator sets into the alternating-current circuit, the reverse-current relay *A* will act, closing the tripping circuits of the oil switches *B* and *C*, thus opening these switches and clearing the local distribution circuit from the high-tension feeders, leaving the battery as the only source of energy to supply the local load. At the same time the relay *A* closes the exciting circuits of the end-cell switch-control relays, and the drop in battery voltage due to its discharge is immediately restored by the automatic operation of the end-cell switches.

London Electrical Engineers (T.F.).—Sergt. Wilfrid Collins is promoted to Sec.-Lieut. on probation.

Water Power Electric Scheme for Bombay.—In remarking that it would appear that the conversion to electric traction of the railway systems of Bombay to cope with the local traffic is likely to be taken in hand much earlier than is generally anticipated, *Indian Industries and Power* refers to a new water-power scheme for providing the necessary electrical energy. It will be an offshoot of the existing Tata Hydro-Electric Co., with the same general manager, namely, Mr. H. P. Gibbs. Sufficient capital is available for developing a further 60.000 h.p., the site of the works being some ten miles north-east of the existing system. There will be a separate power-house and transmission lines, with intercommunication at both ends of the two systems, so that in case of necessity either system can help the other.

LAST WEEK'S AIR RAID

As was stated in the official communication, a power-station in an outlying district of London received some damage during the Zeppelin raid in the early morning of Friday last. This is, we believe, the first instance of damage to a power-station from an air-raid, and he sympathy of supply station engineers will be extended to the popular engineer and manager of the works in question, whom for obvious reasons, we cannot name. Equally is it to be regretted that two employees were injured, one, a switchboard attendant, fatally.

Giving evidence at the inquest, the electrical engineer related how, on receiving notification of the approach of the enemy aircraft, he warned the employees of impending danger. Shortly afterwards bombs were dropped, and the works were thrown into darkness. By the aid of pocket torches the two unfortunate employees who were injured were found, the switchboard attendant, who died shortly afterwards in hospital, being wounded on the head, hands, and face. The coroner's jury returned a verdict that death was due to shock following upon the explosion of a bomb dropped from a German Zeppelin.

AMERICA'S OUTPUT OF ELECTRICAL MACHINERY

A CENSUS of production of the electrical machinery industry of the United States has recently been issued by the Bureau of the Census. In summarising this, *Commerce Reports* (Washington) states that the total value of the products of the electrical machinery industry of the United States increased by practically 50 per cent. between 1909 and 1914. The total number of establishments decreased by 30 in the five years' period in question—namely, from 1,151 1,121; but, eliminating those which make electrical machinery as a subsidiary product, the total number of establishments engaged primarily in this industry increased by 21.

The following table, showing the value of the products of the American electrical machinery industry in 1914 as compared with 1909, the figures for which are given in brackets, is taken from the *Board of Trade Journal* :—

	£	£
Dynamos	4,646,687	(3,446,361)
Transformers	2,624,013	(1,760,204)
Motors	8,835,247	(6,417,496)
Batteries, parts and supplies	4,680,491	(2,122,494)
Carbons (including furnace, lighting, brushes, battery, &c.)	720,548	(386,973)
Arc lamps	148,428	(341,392)
Searchlights, projectors, and focussing lamps	416,309	(187,175)
Incandescent lamps	3,470,077	(3,142,962)
Sockets, receptacles, bases, &c.	1,102,522	(904,346)
Electric lighting fixtures..	676,791	(440,134)
Telegraph apparatus	449,675	(391,486)
Telephone apparatus	4,563,128	(2,851,871)
Electric heating apparatus	806,887	(390,822)
Electric measuring instruments... ...	1,757,301	(1,560,002)
Insulated wire and cables	13,901,115	(10,324,947)
Other products	23,183,315	(13,338,831)

The respective totals are £71,882,534 and £48,007,496.

An Electric Cooking Poster.—Quite the biggest and most striking thing that we have seen for a long time in the way of electric cooking publicity is a poster to hand from the Newcastle-upon-Tyne Electric Supply Company. As this measures 10 ft. by 6 ft. 8 in., and our facilities for viewing artistic productions of these dimensions are necessarily limited, the fitting up of the four portions into which the poster is cut caused quite a diversion in the office. The picture shows a distant view of a tennis court, with a daintily attired lady player in the foreground tending an electric cooker. The artistic effect and rich colouring are impressive enough, and in combination with the simple wording, "Electric Cooking for Cleanliness, Convenience, and Economy," at once tell the story it is desired to convey. We wish, however, that a more practical touch had been given to it, and that an endeavour had been made to get away from the richly dressed lady ironing in the drawing-room type, to which those responsible for electrical pictorial publicity seem so much attached. However, we congratulate the Newcastle Company and the artist on their production at a time when so much is talked of in regard to electrical publicity matters and so little done.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,509.

Explain how the size of a condenser necessary for damping the spark caused by opening a key in a circuit is determined. It is found that on a certain apparatus consisting of lamps absorbing 345 watts at either 100 or 220 volts, a condenser of $2\frac{1}{2}$ microfarads capacity is fitted across the key terminals and for a similar apparatus absorbing only 150 watts a condenser of 0·02 microfarads is fitted. Are these capacities correct, and how will their values be affected if the same lamps are installed on an A.C. circuit of 100 or 220 volts and 50 frequency?—CONDENSER.

(Replies must be received not later than first post, Thursday, Sep. 7th.)

ANSWERS TO No. 1,507.

A batch of 20 squirrel-cage motors is driving centrifugal pumps from the corporation supply. Their full load rated output is 20 h.p., 440 volts, 50 periods, 3-phase, 1,425 r.p.m., but it is found that when pumping a certain liquid, the h.p. required is only 5, and consequently the power factor is bad. Is there any method of improving this power factor which will not be an expensive matter? The motors are started by means of star delta starters with fuses.—"POWER FACTOR."

The first award (10s.) is given to "Control" for the following reply:—

In a case such as this, the cheapest and simplest method of improving the power factor would appear to be by reducing the stator phase voltage, thus reducing the value of short circuit and magnetising current. It is presumed "Power Factor" wishes to have the motors and switchgear so arranged that, in spite of any alteration to improve the power factor when operating at 5 h.p., the machines when required can be easily run at their normal rating of 20 h.p. Therefore, in the absence of full details of the "star delta" switches, it is evident that when only 5 h.p. is required, a reduction in stator phase voltage can easily be obtained by running the motors with the starters in "star" position.

Many "star delta" starters are spring controlled in the "star" position, so that if not changed over to "delta" position the handle returns to "off" position; this spring could in all probability be removed, giving a definite "star" position, but the question should be put before the switchgear makers. Further, in some cases, it is standard practice to connect "star delta" starters, so that the fuses are cut out at starting in the "star" position, and in such case, if the "star" position is to be used as a running connection, the fuses will have to be connected in the mains, so as to be always in circuit.

For a 440-volt, 20-h.p. motor, delta connected, running at 1,425 r.p.m., one might expect a power-factor of ·87 efficiency 84 per cent., short circuit current 108 amps line, 62·5 amps per phase, and magnetising current of 9 amps line, 5·2 amps per phase; the full load current would be 27 amps line, and 15·6 amps per phase. With the switch in the "star" position, the voltage per phase would be $\frac{440}{1{\cdot}73} = 254$, and therefore the short circuit phase current will be $\frac{62{\cdot}5}{1{\cdot}73} = 36$ amps, and magnetising phase current $\frac{5{\cdot}2}{1{\cdot}7} = 3$ amps; these values also represent current as with star connection, the phase current is equal to the line current.

Drawing out the circle diagram, assuming values of short circuit and running light power factor of ·45 and ·1 respectively, we get the power factor at 5 h.p., as ·84 when running with star connection, and ·58 when running with delta connection, thus showing a considerable improvement with the star connection; incidentally an improvement is also obtained in the efficiency due to reduction in iron loss.

The following table shows clearly the comparison between power factor, efficiency, etc: (*a*) with motor running at 20 h.p. delta connected, (*b*) motor running at 5 h.p. delta connected; (*c*) motor running at 5 h.p. star connected:—

	(*a*).	(*b*).	(*c*).
H.-P. developed by motor	20	5	5
Full load line current ...	27 amps.	11 amps.	7·1 amps.
Short circuit line current	108 „	108 „	36 „
Magnetising „ „	9 „	9 „	3 „
Efficiency...	84%	77%	82%
Power factor	0·87	0·58	0·84
Maximum Horse Power	35·7	35·7	11·7

If the alteration to "star delta" starters is impossible, the next best alternative would be to get an auto-transformer wound for primary voltage of 440, and secondary or output voltage of 250. This secondary voltage is, as shown above, the star voltage per phase, and should give satisfactory results. The auto-transformer would require to give an output of 91 kw., ·84 power factor; that is, 108 k.v.a. A change-over switch should be provided to switch the main feed on to either 440 or 250 volts, as required.

The second award (5s.) is made to "E. H." for the following:—

The current taken by an induction motor can be resolved into two components, namely, the active or power component and the reactive or wattless component. The former is in phase with the applied voltage, and supplies the power given out by the motor, together with the losses that occur in the machine. The second component is in quadrature with the supply pressure, and is often referred to as the magnetising current, since it is responsible for the production of the magnetic flux in the motor. On full load, the magnetising current is very small in comparison with the power component, so that the power factor of a 20 b.h.p. 4-pole induction motor may be as high as 0·9. With a small load, the power component is correspondingly less, whilst the magnetising current remains practically unaltered; consequently, the power factor is also low. It therefore follows that in order to improve the power factor on small loads, the magnetising current must be decreased, and this can only be done by working the machine at a lower magnetic flux. Now, since it is out of the question to rewind the stator, the only method of reducing the flux is to reduce the phase voltage, and this can easily be accomplished by means of the star-delta starter. When the latter is in its "running" position, each phase has the whole of the line voltage across it, but if the switch be left on "starting," then the stator winding is connected star, so that the voltage per phase is only 0·58 of the line voltage. The magnetising component of the current is consequently halved, and the power factor greatly improved.

The only disadvantages of working the motors "star" are (1) that the overload capacity of an induction motor varies as the square of the phase voltage. With delta-connection, the 20 b.h.p. motors will stand about 45–50 b.h.p. momentarily, so that with the windings connected star the overload capacity should be about 15 b.h.p.; but since the b.h.p. actually required is only 5, this arrangement appears to be quite suitable. (2) That star-delta starters are generally designed so that the fuses are in circuit only when the starter is in the running position; hence, for continuous operation with star connection, it will be advisable to insert the fuses in a different place, and if they give trouble at starting they can be short-circuited during that period.

A Calculating Rule for Belting.—A convenient form of calculating scale or slide rule for determining the sizes of pulleys, and belts or ropes which will be required to transmit a given horse-power at given speeds of shafting, &c., has been published by Alfred Haworth & Co., Ltd., 84 Leadenhall Street.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published August 24th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

11,321/15. **Rotary Converters.** B.T.-H. Co. and F. P. WHITAKER. A method of starting and self-synchronising rotary converters or other synchronous machinery, involving the use of a direct-coupled starting motor, with a salient pole or equivalent rotor and two primary windings. The rotor poles and the poles of one primary winding are equal in number to the poles of the main machine, and the poles of the other winding are less. In starting up, the latter winding is supplied with current, either in series with the main armature or otherwise, and the set run up to a speed above synchronism. It is then allowed to slow down and lock into synchronism with the first winding in circuit. (Seven figures.)

11,976/15. **Telephone Transmitter.** J. LIDDLE (*Universal High Power Telephone Co.*). An improved microphone capable of working over a great range of tones and overtones, with the associated moving and stationary electrodes so arranged that one set of diaphragms, under the action of the sound waves, compresses the carbon granules and increases the flow of current, and the other set reduces the pressure and decreases the flow. By this means the diaphragms have greater freedom of movement. (Seven figures.)

3,707/16 (*100,978*). **Cable Protection.** C. J. BEAVER and E. A. CLAREMONT. A protective system comprising the following features :—A cable provided with a subsidiary conductor surrounding the main conductors, and a non-metallic waterproof sheathing, separated by a thin layer of hygroscopic insulation. A potential difference is maintained between the subsidiary conductor and earth, and a coil or other suitable device is provided, which is energised on a current of sufficient value passing through the subsidiary conductor, so that it opens a circuit-breaker and disconnects the main circuit.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: MULLER [Insulators] 16,185/15; E. SABERG and J. ANDERSON [Insulating composition] 5,398/16 (*101,067*).

Dynamos, Motors, and Transformers: FEWKES [Conductors and retaining bands] 11,168/15; U.S. LIGHT & HEAT CORPORATION [Dynamo] 11,510/15; SOC. ANON. DES ETABLISSEMENT L. BLERIOT [Generating sets] 11,566/15; SCHAANING and HARLOW [Transformers] 11,568/15; LANCASHIRE DYNAMO & MOTOR CO., WHITMORE and ROBERTS [Short-circuiting and brush lifting gear] 11,790/15.

Electrometallurgy and Electrochemistry: TAINTON [Recovery of zinc] 11,335/15 & 11,336/15.

Heating and Cooking: KRETZ [Connections for irons, &c.] 11,512/15.

Ignition: RANDOLPH [Ignition system] 13,391/15; FURGUSSON [Accessories] 14,819/15; CONNER [Contact-breakers for magnetos] 14,995/15; R. BOSCH [Rotary-interrupter] 17,921/15; W. O. KENNINGTON [Igniton controllers] 5,680/16 (*101,070*).

Incandescent Lamps: B.T.-H. Co. (*G.E. Co., U.S.A.*) [Incandescent lamps] 11,544/15.

Instruments and Meters: B. T.-H. Co. (*G.E. Co., U.S.A.*) [Instrument jewels] 11,715/15; FOSTER [Measuring instruments] 14,214/15.

Switchgear, Fuses and Fittings: BURT and HUNTALITE, LTD. [Candle fittings] 13,901/15.

Telephony and Telegraphy: VAN ESBROECK and CRANSTON [Submarine signalling] 11,325/15.

Traction: BOUND AND ROWLAND [Railway signalling] 11,272/15.

Miscellaneous: MARKS (*Interstate Electric Novelty Co.*) [Batteries] 16,540/15.

Opposition to Grant of Patent

A Grant has been allowed on the following application in spite of opposition:—

22,554/14. **Loaded Telephone Circuits.** BRITISH INSULATED AND HELSBY CABLES, LTD., and H. H. HARRISON. A system of inductively loading duplex telephone circuits in which the same loading coils carry windings for the physical and the phantom circuits, and are arranged to produce no stray field.

Applications for the Suspension of Enemy Owned Patents

605/09. **Electrolysis.** SIEMENS BROTHERS & Co. and 15,128/11, SIEMENS & HALSKE A.G. Licenses under these two patents have been granted on the application of the Refractory Zinc Ore Treatment Co. The patents relate to the use of manganese dioxide electrodes with lead peroxide added to increase the conductivity in the case of the latter patent.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

19,562/02. **Train Controllers.** H. H. LAKE (*G. E. Co., U.S.A*). A form of the device commonly known as the "dead man's handle," in which on the driver releasing his grip of the controller handle the control circuit, and therefore the main circuit, is interrupted, and the air brakes are applied at the same time.

The following are the more important Patents that have become void through non-payment of renewal fees.

Incandescent Lamps: DEUTSCHE GASGLUHLICHT GES. [Filament supports] 16,503/07.

Switchgear, Fuses, and Fittings: T. VON ZWEIGBERGK [Circuit-breaker for series system] 11,304/09.

Telephony and Telegraphy: A. W. SHARMAN [Wireless telegraphy] 11,241/09.

Traction: C. DE KANDO [Bearings for traction motors] 10,647/04; W. M. COCHRANE [Remote control switch for train lighting] 10,729/09.

Miscellaneous: SCHWERIN [Electroosmotic current generation].

ELECTRIC TRACTION NOTES

There is some talk in India of a scheme for running motor-omnibuses in the large towns, and the position of the existing tramways is the subject of some speculation. According to *Indian Industries and Power*, there is a group of Indian gentlemen keenly interested in the development of motor transport there. Some of them have travelled in Europe, America, and Canada, and are impressed with the possibilities of the profitable competition of motor 'buses with the tramway companies. Reading between the lines, it seems probable that the recent success of what has been called the "Jitney" car in America—*i.e.*, ordinary private cars competing with tramways—has been the cause of the movement in question in India. Our contemporary views the position somewhat seriously from the tramway point of view, and speaking of Bombay specially, says that, although it will be many years yet before the local tramway company will be seeking to renew its agreement with the Government, it will be just as well if it prepared now a sound scheme for comfortably carrying the population of the city to and from their daily tasks.

The Oldham Corporation Tramways for last year show a surplus of £4,112, against a loss in the previous twelve months of £5,218.

There was a net profit of £9,697 on the working of the Aberdeen Corporation Tramways undertaking last year, of which one-third may be dealt with outside the undertaking. The Corporation, therefore, has approved of the Tramway Committee's recommendation that £2,000 be allocated to Common Good, and the remaining £1,232 carried forward for such city improvements as the Corporation may desire.

A LARGE D.C. GAS AND STEAM DRIVEN STATION

Under the characteristically American title, "The World's Largest Direct Current Station," the *Electrical World* (New York) gives a detailed description of the former plant of the famous Ford motor-car factory at Detroit, which embodies several unusual features. With a total plant capacity of 65,000 kw., and single units of as much as 6,000 kw. D.C., it is on the unique system of employing slow-speed generators, each mounted on a shaft, with a crank driven by steam cylinders at one end and a crank forming part of a gas-engine at the other end.

The equipment now installed and under construction consists of fourteen 6,000-h.p. and one 4,000-h.p. reciprocating engines of the composite gas-steam type and one 1,500-h.p. steam-engine. These engines are directly connected to 250-volt direct-current, two-wire Crocker-Wheeler generators of 4,000 kw., 2,500 kw., and 1,000 kw. respectively, operated in parallel. Turbo-generators were at first considered for this station, but owing to the inadequate water supply, the gas-engine supplemented by steam was decided upon. While alternating-current generation could have been employed, the factory conditions were such as to favour direct-current operation, and it was considered that the added cost of copper for the latter system would not be more than the extra apparatus required for alternating-current operation.

In order to comprehend the nature of the problem regarding control, writes Mr. F. Allison, electrical engineer to the Ford Co., in the article in question, certain features of the composite gas-steam engine must be understood. In the interest of economy, it is desirable that the proportion of the load on the steam side be held to a minimum, consistent with proper governing in response to load variations as the thermal efficiency of the gas side is greater than that of the steam side. Since it is almost impossible to make gas of a constant quality, the performance of the gas side of a given engine will vary somewhat according to the quality of the gas, the conditions of the igniters, &c. Therefore, if this side of the engine shows unfavourable symptoms, the load of that unit is automatically taken over by the steam side. In operating such large units it is of great importance that the watch engineer has full control of the load on his engine. It will be seen, therefore, that the division of the load between units operating in parallel must, within certain limits, be handled between engines and switchboard, so that the control of the load is handled at the engine. Safety consideration as to the governing makes it desirable that the sudden loss of the working load incident upon the opening of the circuit breaker shall instantly stop the production of power on the gas side. This end is obtained by interrupting the ignition circuit coincident with the opening of the circuit breaker through the medium of a switch provided for that purpose, and functioning with the circuit breaker. Fed from the control magnet, and likewise controlled by this switch, is the gas throttle control magnet, the de-energisation of which results in shutting off the gas supply.

The generators with a rating of 4,000 kw. at 250 volts and 80 r.p.m. are an unusual size. They are of the commutating pole type, with compound field construction. The armature of each is 15·5 ft. in diameter, and carries about a ton and a half of copper, while the commutator is 9·5 ft. in diameter, and contains over two tons. The bus rings, together with the interpole, series, and shunt fields, contribute a ton and a half more of copper, making a total of more than five tons used in the construction of one of these machines. The gas-engines are two-cylinder tandem four-stroke cycle horizontal machines with 42 in. and 72 in. stroke. They develop at full load 3,300 h.p. and weigh 250 tons. Use is made of the waste heat of the exhaust gases for cylinder jacket and feed water heating on the steam side and hot water supply for the factory.

The steam engines are double expansion Corliss valve design with cylinders in tandem on the piston rod. The diameter of the high pressure cylinder is 36 in., while the low is 68 in. The stroke, which is the same as for the gas engine, is 72 in. Steam of 700 deg. Fahr. temperature enters the high pressure cylinder at 180 lb.

The boiler plant when complete will consist of 14 Badenhouse water tube boilers rated at 4,000 h.p. each. A complete coal handling plant is installed.

The principal features of the switchgear lie in the size of the conductors and the circuit breakers owing to the heavy currents employed. The latter are of the well-known I.T.E. pattern and are of triple pole, double throw design, thus controlling positive, negative, and equaliser leads and providing alternative connections with either of the two sets of bars. While equipped for remote control, they are nevertheless, in spite of their large size, and liberal contact areas, capable of being easily closed by hand.

The remote control mechanisms are operated by means of motors, there being one for each pole. Directly associated with these are interlocking devices, so arranged that the poles of the circuit breaker may be closed only in predetermined sequence—*i.e.*, equaliser first, then positive and finally the negative poles. Attention may also be drawn to the remote control motor actuated field regulators and the so-called "gyrostatic voltage balance detector," by which correct voltage relation between an incoming machine and the bus bars is assured when paralleling. This device controls the closing motor of the negative pole of the generator circuit breaker. It consists essentially of a pair of switches in series; the movable members of which are under the control of respective rotary governors mounted on a vertical shaft and driven by a motor immediately below. During the period of use, the field winding of this motor is connected across the mains of the 250-volt control circuit, while its armature is at the same time subjected to the potential difference which exists between the associated generator and bus-bars. The direction of rotation of this armature depends, therefore, upon whether bus-bar or generator voltage predominates, and its speed in either direction depends upon the extent of the voltage difference. By means of a specially designed clutch placed between the motor and the governor shaft, the motion of the former is transmitted to the latter only when the direction of rotation is that caused by a predominance of generator voltage over bus-bar voltage. When rotating in the opposite direction the motor runs free. In connection with each voltage balance detector an automatic cut-out is provided which interrupts the motor armature circuit should the voltage difference attain such a magnitude as to produce a dangerously high speed of rotation. The "low-speed" contact is normally open and the "high-speed" contact normally closed. The circuit breaker, the closing of which this apparatus controls, is of three separate poles, closed in predetermined sequence. The equaliser pole is closed first, and with it auxiliary contacts which control the field and armature circuits of the gyrostat motor. Before it is called upon to operate, the motor has time to assume the speed of rotation corresponding with the voltage impressed upon the armature. When the motor armature is energised in the direction corresponding to generator voltage predominating over bus voltage, the governors, which are under control of calibrated springs, will assume positions corresponding with the particular speed of rotation, the action of the governors being independent of each other up to a certain speed, beyond which as the result of links connecting them with a slight lost motion they act as a unit. It has already been stated that the rotation of the governors only occurs when the direction of voltage difference is favourable to paralleling; when the magnitude of this voltage is such as to give the governor shaft a certain speed of rotation, then the low speed contact is closed. The minimum voltage difference necessary to accomplish this is in the case of the particular apparatus in question, 2 per cent. of the normal voltage, Should the voltage difference, however, amount to 2½ per cent. or more the upper or high speed contact is opened.

Some idea of the magnitude of the switchboard may be gained from the fact that the feeder portion alone is 424 ft. long with 222 panels. Throw over switches are provided, so that any feeder may be connected to either side of the three-wire system. All the conductors are of copper designed for a working density of 750 amperes per square inch. The main feeder board alone is responsible for 120 tons of copper, and the total amount used throughout the entire installation, which comprises one-half of the total present output, is approximately 165 tons.

Transmission about the works, which has a covered floor space of no less than 47½ acres, is by cables in substantial racks over the roofs. There are 178 main feeders leading to local distribution wards, and a complete lamp signalling system keeps the main switchboard operator informed of the position of the switches at these points.

Oxidised Copper Sensitive to Light.—Experiments on the action of light on oxidised copper were described at the June meeting of the New York Electrical Society in a Paper by Mr. T. W. Case. If two copper wires or plates are oxidised and immersed in an electrolyte, a galvanometer connected between them will be deflected when light falls upon one wire or plate. A voltage of about 0·1 was observed. The current obtainable depends upon the area of the plates, the author obtaining about 0·2 ampere. A number of variations of the experiment were described.

TENDENCIES IN TURBO-GENERATOR CONSTRUCTION

SOME notes on recent tendencies in the design and construction of turbo-generators have been contributed to the *Electrical World* by Mr. Philip Torchios. Dealing first with large machines for single-phase railway operations, the author points out that the rotating fields of such generators require a very special construction to counteract the pulsating flux in the field poles caused by the single-phase armature reaction. To prevent serious heating in the field poles produced by the eddy currents, heavy damper windings are required in the poles to neutralise this pulsating flux. The writer proceeds to mention in detail how the difficulties of construction have been overcome in particular generators. The rotors are built up of steel plates held together between heavy stub-end forgings by means of heavy chrome nickel-steel bolts put in place under a heavy initial tension. This construction enables the use of material which is practically uniform in quality in all radial directions, and, having been worked in the forging or rolling process in an axial direction, its properties are excellent in a radial direction. It also permits of the elimination of the through shaft. The plates have portions milled out, and the rotor slots are cut deeper than is needed for the field coils to increase the ventilation by providing these paths for the air, which passes through the rotor axially and is discharged radially.

The caged damper windings for counteracting the pulsating field flux consist of slot copper wedges in one piece, and are also provided in portions of the rotor in which there is no winding. The chrome nickel-steel rings pass over the ends of the windings of the rotor and secure them against displacement on account of centrifugal force, and also carry copper which is inserted in the ring, just within the outer periphery, by dovetailing. Three heavy copper rings encircle each of these cold-retaining rings circumferentially; various copper feeder bars are further dovetailed into the steel rings in an axial direction. A ring of special brass composition and treatment is carefully joined with the steel ring adjacent to the rotor core and engages with the copper bars in the rotor body, thereby assisting materially toward completing the circuit for the currents which are induced in the rotor. The caged winding of the retaining rings completes the circuit of the damper windings and dampens out the pulsating flux arising from the currents flowing into the projecting ends of the stator winding. The rotor for the greater part of its axial length has grooves cut into its surface in a circumferential direction for the purpose of assisting the induced currents to flow in the copper bars provided therefor.

The construction of the stator is characterised by the use of mica insulation, the bracing of the stator coil ends, and improvements in ventilation. Machines so constructed are guaranteed for single-phase kva. rating, at 70 per cent. power-factor, of over 70 per cent. of the three-phase rating, thereby giving considerably more than twice the single-phase output of a three-phase generator of former standard construction. This improvement has made possible material economies in first cost and operation of single-phase power services.

Further progress in turbo-generator design has been made in the size of units. A recent contract for a 45,000-kw. unit has been placed with one of the large manufacturing companies. Experience with the compound turbo-units seems also to warrant expectations of further developments along lines of very large units subdivided in high-pressure and low-pressure units, thereby realising some saving in steam economy over an equivalent single unit and allowing operation of part of the total rating in case of partial disablement. The largest water-turbine generators ever built are those which have been installed during last year in the Long Lake development of the Washington Water Power Company near Spokane, Wash. They have a normal rating of 13,900 kva., and are capable of operating continuously at 25 per cent. overload and 90 per cent. power-factor, with an additional 15 per cent. overload when additional forced-air circulation is supplied to the generator.

The water turbines driving the above generators are rated at 22,500 h.p., and are of the double-inflow horizontal Francis type, each unit being made up of 83-in. twin runners enclosed in cast-iron volute casings and operating at 200 r.p.m. under an effective head of 168 ft. Results from the test runner have indicated an efficiency of 91 per cent. For low-head hydraulic plants the improvements which have been made during the past few years in the scroll cases of reaction turbines, and which have produced marked increase in efficiency, have led to the installation of such turbines in several plants, and in some instances even to the replacement of turbines of older design.

LOCAL NOTES

Aylesbury: *Diesel Engine.*—The Electrical Engineer is to purchase 25 tons of tar oil for the Diesel engine. Messrs. Willans & Robinson, the makers, are naturally taking a keen interest in the trials with tar oil, and have sent, free of cost, slightly altered valves for this purpose. It is anticipated that a saving of 35 per cent. of the fuel costs will be obtained if the tar oil can be worked successfully.

Bo'ness: *Women Cable Layers.*—The fact that the National Electric Construction Co. has, owing to the shortage of labour, been compelled to resort to the use of women for assistance in laying a new power cable, has attracted a good deal of attention in the daily Press.

Dublin: *Street Lighting.*—Experiments have been carried out with half-watt lamps and modern reflectors for street lighting in place of the old type of arc lamps hitherto in use. The main reasons why this step has been taken are the difficulties of obtaining carbons, which before the war came from Germany, and since have for the most part come from America at considerably enhanced prices, and difficulties in securing the glass globes.

Reigate: *Electricity Accounts.*—In reporting a net profit of £33 on the working of the electricity undertaking last year, the Chairman of the Electric Lighting Committee said that, although this could not be regarded as an unsatisfactory result, but rather as one which stood in marked contrast with the heavy losses sustained by many municipal authorities during the recent exceptionally trying period, nevertheless, the prospects for the future still remained anything but promising. All the difficulties of increased costs and the effect of the Daylight Saving Bill remained, and it was not inconceivable that at the end of the current financial year a small adverse balance would have to be faced. From the returns for the last quarter it would seem that the effect of the Daylight Saving Act upon the revenue would be to reduce it by quite £500.

Sheffield: *The Increase in Prices.*—Some curiosity is being expressed in Sheffield as to the manner in which the Corporation will deal with its contract consumers in regard to the increase in prices mentioned on page 312 of our issue for August 17th. It appears that agreements have been entered into with lighting consumers, subject to three months' notice, determinable only in September each year. The *Sheffield Independent* asks how the increases will apply to such consumers, seeing that it is now impossible to give three months' notice terminable at the end of September.

Twickenham: *Increased Charges.*—The Twickenham and Teddington Electric Supply Co. has notified an increase of 10 per cent. in its charges, in order to partially recoup for the great increase in the price of coal and other costs of production.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Miscellaneous

South Africa.—An expenditure of £150,000 is contemplated on additions to the telegraph and telephone systems during 1917.

West Ham.—The Guardians require a three months' supply of electrical fittings. Clerk, Union Road, Leytonstone, September 14th.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Cardiff.—Messrs. Chamberlain & Hookham have been given a contract by the Electricity Department for a twelve-months' supply of meters.

Manchester.—A contract has been placed with Messrs. Chamberlain & Hookham for twelve months' supply of meters.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £128 to £130 (last week, £126 to £128).

The Bastian Co.—The Bastian Electric Heating Syndicate, Ltd., has changed its name to the Bastian Electric Co., Ltd. The company's address, telephone number, and telegraphic address remain as before.

Dry Cells.—According to the *Dublin Evening Mail*, a large factory will shortly be opened in Dublin for the manufacture of dry cells and batteries of all kinds for pocket lamps, telephones, &c. Employment will be given to some 200 hands. The initial output is reckoned at 30,000 batteries weekly.

Russo-British Trade.—The second edition of the Directory of British Manufacturers for Russian Trade, which is printed in the Russian language for circulation in Russia, is now in course of preparation by the Russo-British Trade Exchange, Ltd., 16, Regent Street, S.W. At this address there has been established a Russian reading-room, where daily and trade papers can be consulted, and technical information on Russian requirements obtained.

Italian Agency.—A Genoa agent desires to represent British manufacturers of electrical machinery. Communications to be sent to the British Chamber of Commerce for Italy, 7, Via Carlo Felice, Genoa.

The Concordia Electric Wire Co.—In connection with the winding-up of this company under the Trading with the Enemy Amendment Act, 1916, the Public Trustee, as will be seen from an advertisement elsewhere in this issue, invites tenders for the purchase of the whole or any part of 13,993 Ordinary shares of £1 each, fully paid.

APPOINTMENTS AND PERSONAL NOTES

Mr. S. H. Fowles, having resigned his position as assistant electrical engineer to the Aylesbury Urban District Council, Mr. W. J. Raby, of Horsham, has been appointed his successor. Mr. Fowles goes to Leek as chief electrical engineer.

The Stretford Urban District Council require a switchboard attendant, accustomed to batteries and boosters in a three-wire D.C. lighting, power, and traction station; a battery-room assistant accustomed to lighting and traction batterys, and a test-room assistant with experience in testing, calibration, and repairing meters. Borough Electrical Engineer.

A manager is required for a telephone exchange in the East. See an advertisement on another page.

The Stoke-on-Trent Electricity Department want a switchboard attendant. See an advertisement on another page.

A number of wiremen are wanted. See an advertisement on another page.

CATALOGUES, PAMPHLETS, &c., RECEIVED

BENJAMIN MANUFACTURES.—A short time ago we visited and described the works of the Benjamin Electric, Ltd. (1A Rosebery Avenue, London, E.C.), and it is with interest in this connection that we have received a copy of a pamphlet with the heading, "A Question of Origin," which gives a brief survey of the activities of the company. The letterpress, together with the accompanying photographs of work in actual progress in the various departments, gives an ample impression of the scope of the company's business.

FUSES, MOTOR-STARTING GEAR, &c.—Messrs. Donovan & Co. (47 Cornwall Street, Birmingham) send us a series of illustrated slips dealing with their "Safuses," which have been designed to comply with the Home Office requirements under all conditions; motor-starting gear and panels, also to comply with Home Office requirements; and the "Cornwall" patent fan regulators.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Clyde Valley Electric Power Co.—An interim dividend of $1\frac{1}{4}$ per cent. free of income tax is declared on the ordinary shares.

Oxford Electric Co.—An interim dividend of 2s. 6d. per share has been declared on the ordinary shares.

Brompton & Kensington Electricity Supply Co.—An interim dividend at the rate of 8 per cent. per annum, less tax, is declared on the ordinary shares. Last year 9 per cent. was paid.

NEW COMPANIES

FILBAR ELECTRIC HEATER CO., 24, Coleman Street, E.C. Caiptal £20,000. To acquire from J. F. Barr, of Toronto, certain inventions and patents relating to electric heaters.

THE ELECTRIC CONSULTING & SUPPLY CO., 199 Bath Street, Glasgow. Capital £1,000.

BIRMINGHAM ELECTRICAL ACCESSORIES MANUFACTURING CO., Whitmore Street, Hockley, Birmingham. Capital £1,000.

TRADES DIRECTORY OF ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
Fletcher (H. J.) & Co., Bridge Works, New North Rd., London, N.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sloog, H., 51, Anson Rd., London, N.W.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

HEATING AND COOKING APPARATUS.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
The Bastian Electric Co., Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd, 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Phœnix House, King William St., E.C.

LADDERS.
Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
"Lamlok," 18, Ranelagh Gdns., Hammersmith, W.
London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.

LAMPS (Incandescent)—*contd.*
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

MECHANICAL STOKERS.
Underfeed Stoker Co., Ltd., Coventry House, South Place, E.C.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

MOTORS AND DYNAMOS.
British Thomson-Houston Co.. Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Langdon-Davies Motor Co., 110, Cannon St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PACKING.
Dermatine Co., Ltd., Neate St., London, S.E.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons. Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

RUBBER GLOVES.
Ingram (J. G.) & Son, Hackney Wick, N.E.
Moseley (D.) & Sons, Ltd., Ardwick, Manchester.

STEAM ENGINES AND TURBINES.
Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk St., W.C.
Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
United States Metallic Packing Co., Ltd., Bradford.

SWITCHGEAR.
British Thomson-Houston Co., Ltd., Rugby.
Dorman & Smith, Ltd., Ordsal Electrical Works, Salford.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Electric Control, Ltd., 177, Reid St., Bridgeton, Glasgow.
Ellison (George), Warstone Lane, Birmingham.
Ferguson, Pailin & Co., Ltd., Hr. Openshaw, Manchester.
Ferranti Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Igranic Electric Co., Ltd., 147, Queen Victoria St., E.C.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.

TECHNICAL BOOKS.
Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
Constable (Archibald) & Co., Ltd., 10, Orange St., Haymarket, W.
Crosby Lockwood & Son, 7, Stationers' Hall Court, E.C.
Macmillan & Co., Ltd., St. Martin's Street, W.C.

TELEPHONES.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Graham (Alfred) & Co., St. Andrew's Works, Crofton Park, S.E.
Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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The Government has decided that strict economy in paper is necessary and, in consequence, to prevent waste, the majority of newsagents and bookstalls will limit their stocks so far as possible to the actual known requirements of their customers. A mere verbal order will, however, be sufficient to ensure that a copy is sent or reserved weekly.

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SUMMARY

We publish an article dealing with the progress of electric drive for steel mills. The robust construction of the induction motor makes it preferable to the continuous-current motor, but there are difficulties in obtaining satisfactory speed regulation of the former. The writer discusses two ways of producing continuous-speed regulation—namely, the rotary-converter method and the commutator regulating-motor method (p. 340).

Among the patent specifications of electrometallurgical interest published in August are two relating to electrolytic reduction of metals (p. 341).

The first annual report of the committee of the Privy Council for scientific and industrial research has just been issued. Grants have been made for the continuance of researches which were in danger of abandonment owing to the war, as well as for the carrying out of new investigations both by individuals and institutions. A largely increased supply of competent researches is needed, and it is proposed to establish research scholarships (p. 342).

Our Questions and Answers page this week deals with the relative outputs obtainable from an armature when run as a C.C. generator, an A.C. generator, and as a double current generator (p. 343).

Among the subjects of Specifications published at the Patent Office last Thursday were submarine sound detection, metal filaments, and insulating material. A patent for the electrolytic preparation of calcium expires this week after a full life of fourteen years (p. 345).

There was a net profit of £31,445 on the Portsmouth Tramways last year.—A statement of sums which should be set aside annually for depreciation has been prepared by the Burnley Tramways Manager (p. 345).

The Aberdeen Electricity Department had an exceptionally good year in 1915–16, the net profit being £8,792.—The Shipley Corporation is not disposed to proceed further with the proposed linking-up scheme with Bradford (p. 346).

A loan of £9,610 has been sanctioned at Walthamstow, and supplies of electric lamps are required by H.M. Office of Works, the Warrington Guardians, and the London County Council (p. 346).

1st LONDON ENGINEER VOLUNTEERS

Headquarters, Chester House, Eccleston Place.

Orders for September, 1916, by Lt.-Col. C. B. Clay, V.D., Commanding.

General Parade.—A General Parade will be held on Saturday, Sept. 30th, at 2.45, at Headquarters. Uniform.

Lectures.—W. Eyles, Esq. (late R.E.) has kindly consented to give four lectures as follows:—

Wednesdays, Sept. 6th and 13th, "Bridging."
Wednesdays, Sept. 20th and 27th, "Demolitions."

Members are requested to take special note that, during this month, the lectures will be on *Wednesdays* in place of Tuesdays.

Drills.—Drills will be held under the Sergeant-Major on Tuesday evenings, as during August.

Musketry.—The Range will be open on Thursday evenings, as during August.

Instruction Classes.—Instruction Classes at Regency Street will be held as usual for Platoons Nos. 9 and 10.

Entrenching.—Every Sunday at Victoria Station (S.E. & C. Ry.) Booking Office, 8.45 a.m. Uniform, haversacks, and water-bottles. Midday rations to be carried. The importance of a steady continuance of this work cannot be over-estimated. It has been pointed out by Major-General Dickie that the work is best done by moderate working parties *every* Sunday. "Half the number on consecutive Sundays is much better than double the number every other Sunday."

The Commandant desires to draw attention to the Report on Work Done on South London Defences in July, 1916, in which the paragraph referring to the Corps says: "The work has been very well done, and the task completed," and to express his gratification at the support he has received.

A *précis* of this Report, and the General Order recently issued is posted at Headquarters.

Otford Camp.—A most successful Camp was held during the early part of August, and some 20 men are still under canvas.

Special Note.—Ordinary Drills will be resumed on and after Sept. 18th. Supplemntary Orders will be issued later.

Corps Meeting.—A General Meeting will, if possible, be held at the end of September.

THE BRITISH ASSOCIATION

The 1916 meeting of the British Association was opened in Newcastle on Tuesday, when Sir Arthur Evans, F.R.S., delivered his Presidential Address, but as this dealt with New Archæological Lights on the Origins of Civilisation in Europe, it needs no reference here.

Yesterday, Wednesday, the work of the sections was commenced as usual. Section G had as President Mr. G. G. Stoney, F.R.S., and his address was another contribution to the subject of how best to organise the engineering industry after the war so that the utmost can be obtained out of both workmen and machinery, and at the same time harmonious relations maintained between employers and employees. We will deal with the matter more fully in our next issue, and will merely mention here that Mr. Stoney's view is that it is more important for an employer to get large output than to pay small wages.

The programme of Papers before Section G was given on page 311 of our issue for August 17th, and with the exception of the withdrawal of the Paper by Professor Coker, was carried through. There is not a great deal of electrical interest in it, but a number of matters will bear further reference in our next issue.

The question of the scientific use of fuel took a prominent part in the meeting of the various sections concerned, and a joint meeting is to be held to-morrow, Friday, between the Engineering and Chemistry Sections on the matter, whilst to-night, Thursday, Professor W. A. Bone, F.R.S., gives a lecture on Combustion.

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

MOTOR DRIVE FOR STEEL MILLS

THE progress of electric drive for steel mills in the United States forms the subject of a contribution to the *General Electric Review* by Mr. F. B. Crossley, who states that during last year, motors with an aggregate continuous rating of approximately 75,000 h.p. have been added by a single manufacturer to the grand total of main roll drive in that country. Without the electric motor the steel industry, says the author, could certainly never have reached its present magnitude and marvellous efficiency.

Although direct-current motors for main roll drives were first in the field, the greater simplicity and unquestioned ability of the induction type to stand abuse soon left for the direct-current motor only a somewhat restricted application to reversing mills, and to those requiring adjustable speeds, constant under varying loads. Not content with the prestige already won by the induction motor in constant speed mill applications, greater effort was put forth to replace direct current for adjustable speed drives. Several schemes, each a compromise, have been suggested and tried out in actual service where more than one speed was required. The most common arrangement is perhaps the multi-speed motor with one or two windings. Two speeds with a 2 : 1 ratio can be readily obtained with a single winding or a maximum of four speeds with two independent windings, each winding having leads brought out for two 2 : 1 speeds. In steel mill work it is rarely possible to select four synchronous speeds bearing the right relation to one another and to the mill requirements. Furthermore, while the efficiency of such a machine is good, the power-factor at the lower speeds, particularly for 60-cycle motors, is very poor and the cost very high.

A second method employs what is known as operation in concatenation. Two induction motors, one of which at least must have a phase-wound rotor, are arranged on a common shaft and base. One or both of these machines may have either a double or a single winding, and either may be operated independently of the other at its respective synchronous speed or speeds. Other speeds in concatenation, or cascade as it is sometimes called, may be obtained by connecting the secondary windings of the first motor to the primary of the second motor while the primary of the first is connected to the power circuits. The concatenated speed can be readily determined from the effective number of poles, $\frac{P_1 \pm P_2}{2}$ where P_1 equals the number of poles in the first motor and P_2 the number of poles in the second.

The third and simplest method of obtaining speed control consists merely of inserting an adjustable resistance in the secondary circuit of the induction motor. So long as the load remains constant the speed will remain constant for any given setting of the controller. Unfortunately, however, the average steel mill load is made up of a series of peaks interspersed with periods of friction load only. It should be obvious, therefore, that the series speed characteristic obtained with rheostatic control is entirely unsuitable for main roll drives. In view of this fact, it is astonishing to note how frequently motor manufacturers are requested to quote rheostatic control for main line drives. A second serious objection to rheostatic control for mill drives lies in the fact that for constant torque the input to an induction motor is constant, irrespective of speed. To keep this point clearly in mind, it is well to consider the machine under normal operation as combining two functions—first, a pure motor action transforming electrical to mechanical energy, and, second, a simple transformation of electrical energy of primary frequency and voltage to a secondary frequency and voltage. At standstill the motor acts as a crude static transformer with maximum potential and line frequency at the slip-rings. As the motor accelerates the slip-ring frequency and voltage approach zero at synchronism with constant torque; therefore, at half-speed, neglecting losses, 50 per cent. of the input becomes useful work at the shaft and 50 per cent. is dissipated as heat in the external secondary resistance. In other words, with rheostatic control, the efficiency is reduced in proportion to the reduction in speed. No matter whether the torque increases, decreases, or remains constant with change of speed, the secondary losses are always equal to

$$\frac{\text{slip}}{1 - \text{slip}} \times \text{shaft horse-power.}$$

It is evident, therefore, that both from the standpoint of speed characteristics and efficiency, rheostatic control is not desirable for rolling mill drives.

Out of a very considerable number of more or less experimental methods of applying the adjustable speed a.c. drive, two, the so-called Kraemer and Scherbius systems, emerged on a commercial basis. In the autumn of 1912 a proposition to build a speed-regulating set was made to the U.S. Steel Corporation in connection with the two-speed 6,500 h.p. universal plate mill motor at Gary, which is said to be the largest induction motor yet built for steel mill service. It has a continuous overload capacity of 8,150 h.p. and a maximum torque corresponding to approximately 24,000 h.p. It is of interest to note that many of the features incorporated in the Gary motor have since become recognised standard requirements in a.c mill motor design. The massive frame and bearings, the steel rotor spider, adjustable end thrust device and provision for sliding the stator parallel to the shaft to clear the rotor for examination, are all standard features. The arrangement proposed in 1912 was what is known as the rotary converter system of dynamic speed regulation. This

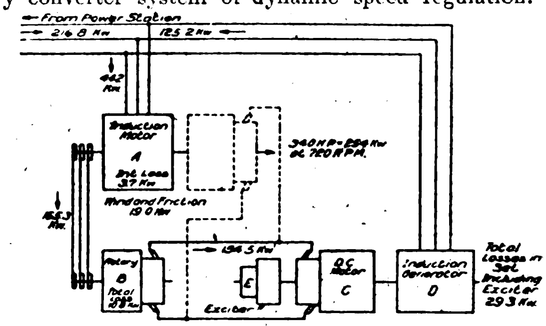

FIG. 1.—A ROTARY CONVERTER METHOD OF SPEED CONTROL FOR INDUCTION MOTORS.

consists briefly of a suitable rotary converter taking the slip energy of the main motor at varying frequency and voltage, and converting it to direct current at proportionate voltage. This direct current was to drive a motor-generator. The d.c. motor, on account of the large capacity involved, was laid out in two units with their armatures in series, the fields being separately excited. The driven unit is a standard induction motor; hence, when driven slightly above synchronism with its primary connected to the power system, it operates as an asynchronous induction generator and returns to the system energy proportional to the reduction in speed of the main roll motor. Speed control is obtained by manipulation of the d.c. motor field. Strengthening this field reduces the speed, and weakening the field increases the speed, of the main motor. The speed characteristic becomes practically that of a shunt wound d.c. motor with field control, the speed remaining constant for any given setting independent of variation in load.

Fig. 1 shows a diagramatic arrangement of connections with distribution of losses as calculated for a definite condition. *A* is an 800-h.p. induction motor at 1,200 r.p.m.; *B*, a 160-kw. rotary; *C*, a 208-h.p., d.c. motor; *D*, a 150-kw. induction generator. With 254 kw. (340 h.p.) at shaft and 422 kw. input to the motor at 720 r.p.m., there are 3.7 kw. loss in main motor, 10.8 kw. loss in rotary, and 29.3 kw. loss in motor-generator; leaving 125.2 kw. of slip energy to be returned to the system and showing an efficiency of 80 per cent. with rotary regulating set as compared with 57.5 per cent. for rheostatic control. This also shows the original Kraemer idea of connecting the auxiliary d.c. motor to the shaft of the main motor and returning the slip energy mechanically.

Where the minimum speed of the main motor is sufficiently

high, and where constant power or increasing torque at reduced speed is required, this arrangement is sometimes used. Generally speaking, however, the slow speed direct connected d.c. motor will cost quite as much as or more than the higher speed d.c. motor and induction generator, since when forming a part of the mill unit it must be built sufficiently rugged to meet mill service, whereas if a separate set is employed the standard industrial construction is satisfactory. Furthermore, the separate set can often be placed in a room apart from the mill along with the control, and better operating conditions can be maintained.

Shortly after the Gary universal plate mill proposition was submitted, the Forged Steel Wheel Company placed an order for one 1,300-h.p. and one 600-h.p. motor, each with speed-regulating sets of the Scherbius type. The set for the 1,300 h.p. motor is of 450 k.v.a. capacity and is designed to give continuous speed control from 214 to 140 r.p.m. It consists of a polyphase commutator regulating motor direct-coupled to a standard squirrel-cage motor operating as an induction generator, and to a small exciter which is in construction practically a duplicate of the commutator motor.

Fig. 2 shows schematically the general character of punchings and connection of windings. The main interpole compensating and armature windings are clearly indicated. The secret of perfect commutation lies largely in the proper design of the compensating winding, which is fully covered by the Scherbius patents. The polyphase commutator regulating

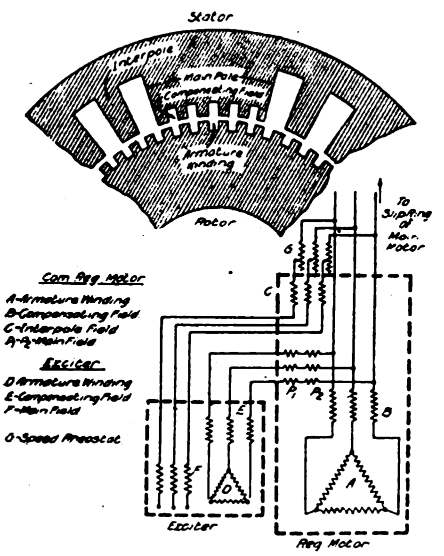

FIG. 2.—DIAGRAM OF PUNCHINGS AND CONNECTIONS OF THREE-PHASE COMMUTATOR REGULATING SET.

motor is in effect a shunt wound machine with a series speed characteristic, due to the effect of increasing the armature voltage while maintaining constant excitation. It is this series speed characteristic which renders possible the induction generator action of the squirrel-cage motor.

As compared with the polyphase commutator regulating motor, the rotary converter system will always involve one more machine when two systems are laid out on the same basis. If the separate motor-generator set is used, the rotary converter system requires four machines, as against three, with the polyphase commutator regulating. If the d.c. motor of the rotary converter system or the commutator motor are respectively direct connected to the main motor, the rotary converter system will require three units and the polyphase commutator regulating but two.

From the standpoint of power-factor, it is generally considered poor practice to attempt correction with a rotary, whereas the design of the polyphase commutator regulator readily lends itself to this end. The use of regulating sets need not handicap the desirable characteristics of the mill type induction motor as regards torque, heating, or efficiency, and should in every case improve the normal power-factor. The customary guarantee of 250 per cent. maximum torque can readily be met with the polyphase commutator regulating set from maximum regulation to within a slip frequency of about one cycle, whereas with the rotary converter the tendency to fall out of step at low frequency limits the 250 per cent. torque guarantee to about 8 cycles slip frequency which, on a 25-cycle circuit, means that 250 per cent. torque cannot be guaranteed at regulation less than about 30 per cent. In many cases, therefore, the maximum torque throughout the entire speed range required is greatly reduced, except at prohibitive expense.

ELECTRO-METALLURGICAL PATENTS PUBLISHED IN AUGUST

TWO patent specifications by V. C. Tainton (numbered respectively 11,335 and 11,336 of 1916) deal with electrolytic reduction of metals. The first describes a cyclic or continuous process for extraction of zinc, in which the zinc salt solution is regenerated by dividing it into two parts and treating fresh ore with one portion, thereby to dissolve the zinc and neutralise the acid content, and afterwards mixing the neutral solution with the remaining portion for further treatment by electrolysis at a high current density. The second specification is for an apparatus for the electrolytic recovery of metals from solutions comprising a series of anode elements alternating with a series of cathode elements. The latter have each a porous support upon which a coating of comminated conducting material is deposited out of a solution carrying the material in suspension and means for passing a metal-bearing solution through the comminated conducting material and passing sufficient current to extract the metal.

South Wales and Monmouthshire School of Mines.—The calendar for the approaching session at the South Wales and Monmouthshire School of Mines, Treforest, is now published. The school was established by the principal coalowners in the South Wales and Monmouthshire coalfield, and is supported and maintained solely at their expense. Instruction of an advanced and practical character is provided for the purpose of training all grades of colliery officials, and research work into the causes and prevention of accidents is carried on. The institution is open to all students over 16 years of age on equal terms, who have sufficient practical experience and elementary technical knowledge to enable them to benefit from the training provided. Preference is given to students who have successfully completed the courses arranged in mining and engineering by the County Council or other Education Committee.

NEW COMMITTEES FOR MINING AND METALLURGICAL INTERESTS

THE Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research has appointed three Standing Committees on metallurgy, mining and engineering. The names of the members of these Committees are given in the first annual report of the Council published this week. They are as follows:—

Standing Committee on Mining.—Sir William Garforth (Chairman of the Committee and of the Section on Iron, Coal, and Hydrocarbons), Mr. Edgar Taylor (Chairman of the Section on Mining and other Minerals), Sir Hugh Bell, Bart., Lieut.-Col. W. C. Blackett, Mr. Hugh Bramwell, Professor John Cadman, Mr. W. Gascoyne Dalziel, Professor William Frecheville, Mr. John Haldane, F.R.S., Mr. Edward Hooper, Professor Henry Louis, Mr. Bedford McNeill, Mr. H. F. Marriott, Mr. R. T. Moore, Sir Boverton Redwood, Bart., Mr. C. E. Rhodes, Mr. Wallace Thorneycroft.

Standing Committee on Metallurgy—Sir Gerard Muntz, Bart. (Chairman of the Committee and of the Non-Ferrous Section), Sir Robert Hadfield, F.R.S. (Chairman of the Ferrous Section), Professor J. O. Arnold, F.R.S., Sir William Beardmore, Bart., Mr. Arthur Balfour, Professor H. C. H. Carpenter, Mr. C. H. Desch, Mr. F. W. Harbord, Mr. J. Rossiter Hoyle, Professor A. K. Huntington, Mr. W. Murray Morrison, Mr. George Ritchie, Mr. J. E. Stead, F.R.S., Mr. H. L. Sulman, Mr. Frederick Tomlinson.

Standing Committee on Engineering.—Sir Maurice Fitzmaurice, C.M.G. (Chairman), Mr. James Brown, Mr. Dugald Clerk, F.R.S., Mr. F. R. Davenport, Sir Archibald Denny, Bart., Mr. Alfred Herbert, Mr. J. S. Highfield, Professor Bertram Hopkinson, F.R.S., Mr. C. H. Merz, Mr. V. L. Raven, Mr. A. A. Remington, Mr. Herbert Rowell, Mr. Alfred Saxon, Mr. G. Gerald Stoney, F.R.S., Mr. Douglas Vickers, Professor Miles Walker

RELATIONS BETWEEN SCIENCE AND INDUSTRY

IN July last year a Government scheme was projected for the organisation and development of scientific and industrial research. This scheme provided for the establishment of (*a*) a Committee of the Privy Council responsible for the expenditure of any new moneys provided by Parliament for scientific and industrial research; (*b*) a small Advisory Council responsible to the Committee of Council and composed mainly of eminent scientific men and men actually engaged in industries dependent upon scientific research. The primary functions of the Advisory Council were to advise the Committee of Council on (i) proposals for instituting specific researches; (ii) proposals for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades; (iii) the establishment and award of Research Studentships and Fellowships.

The first annual report of the Committee of the Privy Council has just been issued, and shows the progress that has been made during the past year. The report opens with the statement that the Committee has approved recommendations from its Advisory Council in respect of aid to twenty scientific investigations of industrial importance. It has also approved grants to a number of individual research workers, both students and others, which will amount at the close of the academic year 1916-17 to a sum not exceeding £6,000. The amount placed by Parliament at the disposal of the Committee for the year 1915-16 was £25,000, of which £12,241 was expended in the last months of that year. For the current financial year the vote was £40,000.

A detailed report of the Advisory Council opens with a review of the past 16 years, showing what the Government has done during that time towards the organised support of our trades and industries; reference is made to the support given to the National Physical Laboratory, the Engineering Standards Committee, the Imperial Institute, and the Imperial College of Science and Technology.

In arranging for its work in the immediate future, the Council has decided to give science in its application to industry precedence over pure science. The members are not under any misapprehension as to the relations between pure and applied science: they quite recognise that applied science is nothing but the application of pure science to particular classes of problems. At the same time, the Council realise that they have to deal with a practical business world, in whose eyes a real distinction seems to exist between pure and applied science. The managing director of one firm told the Council that he had no interest in research which did not produce results within a year. He wanted a handy servant, not a partner with ideas of her own. This was the position from which the Council had to make a start. There was, moreover, another consideration which alone would have compelled the Council to begin with research of directly industrial application. The Universities, which are the natural homes of research and pure science, have been so depleted of both students and teachers by the war that they are barely able to continue their routine work, and can command at the moment neither the leisure nor the detachment of spirit that are essential conditions of original research.

The first inquiries of the Council showed that there were certain researches being conducted or directed by professional associations in the period preceding the war, which stood in grave jeopardy of enforced abandonment. These investigations had been paid for by the voluntary contributions of several great engineering and other professional societies, and thus carried with them the best guarantees of their necessity and effectiveness. The Council decided, therefore, to save as many of these derelict researches as possible, and accordingly recommended the payment of a series of grants to the societies concerned. In one case they have even obtained by negotiations with the War Office the release of the investigator in charge of the research from his military duties, and improved the financial and scientific conditions of his work.

The chairman and other officers of the Council have interviewed representatives of the leading scientific and professional societies, and they discovered what, indeed, is well known, that in the main the most highly organised industries are those which have made most use of scientific research, and are consequently most ready for, though possibly not most in need of, the encouragement it is our duty to afford. The engineering trades, with their attendant group of distinguished professional societies, have long been alive to the need and value of scientific research, while the chemical trades for the most part are so divided and individual in outlook that the various professional societies have had neither the influence nor the means necessary to enable them to take any large share in promoting research in connection with those industries. The textile trades, highly organised as they are on the economic side, had made even less progress in the systematic use of science. They had been content for the most part to leave science to the dyers and the dye-stuff manufacturers, or to the engineers who supplied them with machinery, without much care in either case as to their nationality.

While these inquiries and interviews were taking place, the Council had invited the assistance of the universities and technical colleges of the country in the formation of a register of researches actually being conducted on the outbreak of the war. Together with the name of the worker and the subject of the research, the register gives the date of its beginning, and, if it has been temporarily suspended, the cause of its abandonment. In collecting these particulars from the technical schools and colleges the Council were greatly assisted by the inspectors of the Board of Education. It was not enough, however, to know what original work was going on, who was doing it, or where it was being done; a careful survey was needed of the amount and the character of the provision made in our higher educational institutions for research work, and the Council have begun such a survey as a part of their preparatory arrangements for a systematic programme of aid to individual researchers. In discussing the general aspect of the question of aid to research in educational institutions, the Council point out that they recognise the danger there is in bringing technical problems too pressingly to the notice of teachers and students in educational institutions. Those capable of making advances in natural knowledge must not be tempted to abandon their austere studies for the sake of solving temporary and local technical problems. Still less must students be encouraged to take up such questions except as stimulating incidents in their general training. On the other hand pure science has in the past owed much to observations, suggestions, and difficulties which have come from activities external to the laboratory or study. So will it be again; and the Council desired so to order the relations of workers in pure science to the industries going on around them that they may receive the stimulus of a wider outlook than is always attainable under the limitations of an academic system of syllabus and examination.

At one time the five great engineering societies—the Institutions of Civil, Mechanical, and Electrical Engineers, the Iron and Steel Institute, and the Institution of Naval Architects—submitted a petition to the Privy Council urging that the Advisory Council should be enlarged by the inclusion of representatives of the several branches of engineering. It had already been decided, however, to establish standing committees representing various branches of industry, and the societies therefore submitted their nominations for these Committees to the Advisory Council. Three Standing Committees, the names of which we give elsewhere in this issue, have already been set up on engineering, mining, and metallurgy. It is pointed out that other Standing Committees are contemplated. One may be necessary for fuel. Possibly another for rubber, and a third for the chemistry of cotton and paper. A Standing Committee for textiles, with special sections for cotton, wool, and silk, is also likely to be needed before long.

In the course of their report the Council state that we have not yet learned how to make the most of mediocre ability—particularly in things of the mind—yet without the scientific

rank and file it will be as impossible to staff the industrial research laboratories which are coming as to fight a European war with seven divisions. There is as much place and need for plodding labour in scientific research as in other kinds of work. The responsibility for dealing with the grave situation anticipated rests with the education departments of the United Kingdom. The State will be able to do something to encourage a longer period of training by the offer of Research Studentships and the like; but that will not suffice. It is useless to offer scholarships if competent candidates are not forthcoming, and they cannot be forthcoming in sufficient numbers until a larger number of well-educated students enter the universities. That is the problem which the Education Departments have to solve, and on the solution of which the success of the present movement largely depends.

In conclusion, the Council state two conditions which are essential for the success of their work. These are, first, a largely increased supply of competent researchers; and, second, a hearty spirit of co-operation among all concerned: men of science, men of business, working men, professional and scientific societies, universities and technical colleges, local authorities, and Government departments. And neither condition, states the Report, will be effective without the other.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,510.

Give a *brief* outline of the method followed by a manufacturer in designing industrial D.C. interpole motors, using standard frames, punchings, &c., whose magnetic and electrical characteristics are known from tests.—R. R.

(Replies must be received not later than first post, Thursday, Sept. 14th.)

ANSWERS TO No. 1,508.

State the relative volts and amperes that can be obtained from a given interpole, self-excited dynamo, having wave-wound armature when run (*a*) as a continuous-current generator; (*b*) as an alternator; (*c*) as 50 per cent. C.C. and 50 per cent. A.C. generator. For alternating current give figures alternatively for two and for three slip rings. What is the relative heating obtained, and what special magnetic and electrical considerations must be observed, beyond those arising in ordinary direct-current design?—Koil.

The first award (10s.) is given to "Arc" for the following reply:—

Let I_d and I_s be the currents taken from the armature at the commutator, and at each slip-ring respectively, and let m be the number of slip-rings, and cos. ϕ the power-factor on the A.C. side; then the D.C. load of I amperes that will give rise to the same amount of heating in the armature winding can be determined from the following formula (which is derived in a similar manner to that for a rotary converter, except for the signs):—

$$I^2 = I_d{}^2 + \frac{I_s{}^2}{\sin\frac{2\pi}{m}} + \cdot 573\, m I_d I_s \cos\phi$$

[This formula is developed in another form by Carr in "Armature Copper Losses in Rotary Converters, etc.," *J.I.E.E.*, Vol. 54.]

From the above it follows that when $I_s = O$, $I_d = I$, and when $I_d = O$, $I_s = I$, for 1-phase ($m = 2$), and $= \cdot 86\ I$ for 3-phase ($m = 3$). Also, if $I_s = I_d$ and cos. $\phi = 1$, $I_s = \cdot 56\ I$ for 1-phase, and $= \cdot 50\ I$ for 3-phase, and if $I_s = I_d$ and cos. $\phi = O$, $I_s = \cdot 71\ I$ for 1-phase, and $= \cdot 655\ I$ for 3-phase.

Similarly for any other kind of load, the relationship of the D.C. and A.C. currents to the full-load current of the machine as a D.C. generator can easily be determined from the above expression.

As regards the voltages, it is well known that for a machine having the ratio $\frac{\text{pole arc}}{\text{pole pitch}}$ equal to about 0·7, the relationship between the pressures across the slip-rings and across the commutator—when the machine is unloaded—is given approximately by: $E_s = \frac{E_c}{\sqrt{2}} \sin\frac{\pi}{m}$ *i.e.*, for 1-phase, $E_s = \cdot 707\ E$, and for 3-phase, $E_s = \cdot 612\ E$.

On load the relationship will be slightly altered, due to the voltage drop in the armature winding, and to the effect of armature reaction upon the distribution of the magnetic field.

In the above calculations the effect of the exciting current upon the heating of the armature has been omitted, as it is generally so small as to be negligible.

In the construction of the machine care must be taken to connect the tappings to the armature winding, so as to get the phases as balanced as possible. Other considerations, such as the need for damper windings, etc., depend very largely upon the size of the machine and the conditions under which it has to work. Thus, if the machine is to give full load as a single-phase generator, or if it has to run in parallel with other alternators, it will be necessary to fit amortisseurs to the pole-shoes. The presence of the commutating poles will assist in increasing the armature reaction when the machine will be working as an alternator, so that it will be advisable to make the air-gap under these poles as large as is practicable.

The second award (5s.) is made to "Flash" for the following:—

To show the relative volts and amps which could be obtained under the various conditions quoted, we will take the case of an armature wave wound suitable for generating an output when running as (A) a D.C. dynamo of 100 volts, 50 amps full load; (B) the following outputs would be obtained when running as an alternator and fitted with:—

(1) Two slip-rings: It would then be developing a single-phase current. Assuming the machine generated a sine wave current, the theoretical voltage would be ·707 × D.C. volts = 70·7 volts. The current permissible for the same heating as when generating wholly D.C. current would be the same = 50 amps. R.M.S. value, as read on an ammeter suitable for the frequency of the supply, the frequency of supply being

$$= \frac{\text{Speed R.P.M.} \times \text{No. of poles.}}{60 \times 2.}$$

(2) Three slip-rings: A 3-phase current would be generated, with a voltage between the slip-rings of ·612 × D.C. volts = 61·2 volts. The permissible line current per phase would be ·866 × D.C. amps = 43 amps.

(C) When developing 50 per cent. D.C. and 50 per cent. A.C. For the same temp. rise the D.C. output would be 100 volts, 23 amps. A.C. output would be 61·2 volts, 23 amps, 3-phase.

When designing a generator to give both D.C. and A.C. current it is necessary, apart from the usual considerations observed in ordinary direct current design, to arrange all details such that the conditions result in obtaining a sinusoidal wave in the A.C. circuit. With this end in view the following rules must be observed:—

(1) The armature winding must be symmetrical as a whole, and also with regard to the phase tappings. (2) The ratio of pole arc to pole pitch should be less than the usual value for D.C. machines, and in this connection it has been shown that the third harmonic, which is the one mostly to avoid or keep down, is least when this ratio is ·66, with a full-pitch winding. (3) The air gap should be as large as compatible with the design to reduce the armature reaction as much as possible, and thereby keep up the regulation. (4) The number of turns per commutator bar should be as low as possible. (5) If the slip-rings are used in connection with a static balancer for purposes of a 3-wire system, the interpole wind-

ing, and, if any, the series winding, must be divided in two halves, "north" poles on one side and "south" poles on the other, and one half connected in each D.C. main. This is in order that the out-of-balance current of either side will flow through these windings and have the desired effect.

ANSWERS TO CORRESPONDENTS

UNICO.—For answer to your question see ELECTRICAL ENGINEERING, August 10th, 1916, p. 305.

A LARGE CABLE CONTRACT

WITH reference to the article on page 330 of last week's ELECTRICAL ENGINEERING describing the large cable contract executed by W. T. Henley's Telegraph Works Co., Ltd., for the London and North-Western Railway, we

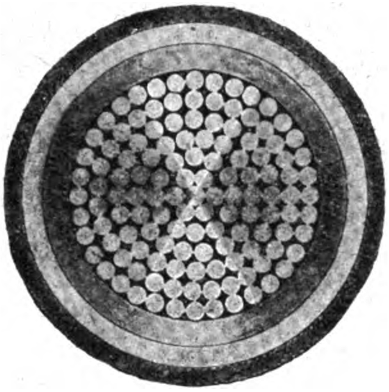

FIG. 1.

are now able, through the courtesy of Messrs. Henley's, to give illustrations of sections of two of the classes of cables supplied.

Fig. 1 shows a section of a one-square inch paper insulated, lead covered, Hessian taped cable, of which $5\frac{3}{16}$ miles were

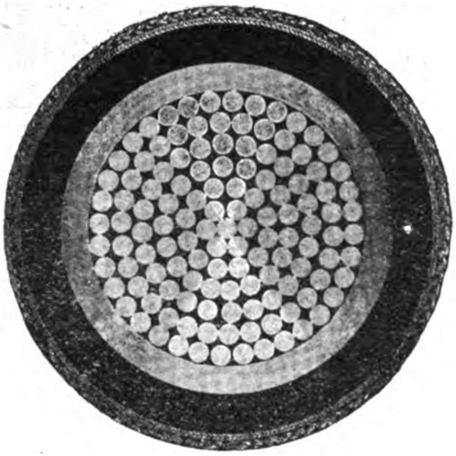

FIG. 2.

supplied as well as four miles of 1.25 sq. inch cable to the same specification.

Fig. 2 illustrates another type of cable of 1.25 sq. in. section, paper insulated vulcanised bitumen sheathed taped and braided cable of which 8 miles were supplied in addition to $1\frac{3}{4}$ miles of 1 sq. in. cable to the same specification.

Birmingham and District Electric Club.—The next monthly meeting will be held at the Swan Hotel, New Street, on Saturday next, September 9th, at 7 p.m., when a paper on "Sand Blasting and Sand Blast Machinery," will be read by Mr. J. J. Richardson.

Thermit, Ltd.—It is announced that the whole of the shares of Thermit, Ltd., which has been wound up under the Trading with the Enemy Amendment Act, have been acquired by the Birmingham Metal and Munition Co., Ltd. Thus the company is now British, and will continue to trade as hitherto.

NEW COMPANIES

PERSIAN GULF AND MESOPOTAMIA DEVELOPMENT CO., Whitehall House, Charing Cross, S.W. Capital £50,000, half preference and half ordinary £1 shares. To adopt an agreement with H. M. Kilby, trading at Kilby & Co., and others to construct and work tramways, power stations, etc., and to act as bankers, financiers, merchants, and contractors for public and other works.

STEEL'S ELECTRIC AND ENGINEERING CO., 206 East India Dock Road, E. Capital £3,000.

Guaranteed Wiring.—Some time ago we noted that the scheme of the Electrical Contractors' Association for modifying its articles of association in order to guarantee work carried out by its members, was refused sanction by the Board of Trade, and that another way out of the difficulty was being considered. The September issue of *The Electrical Contractor* states that owing to the refusal of the Board of Trade to register the alteration of articles with regard to the Guarantee of Work Scheme, it was found desirable to look carefully into the question of incorporation and the articles and powers under which the Association was acting, and on going into the matter with the solicitors it was found necessary to form two new associations: (1) a Limited Liability Company for the purpose of trading; (2) a Trades Union for the purpose of dealing with workmen. These associations have now been formed, the first being called the "N.E.C.T.A.," Ltd., which had been registered at Somerset House, and for which a licence had been obtained to carry on business, and the second the National Federated Electrical Association, which is an unregistered association.

Motor Field Operating Theatre.—One of the notable features of the Motor Field Operating Theatre about to be presented to the Italian Government by the Wounded Allies Relief Committee, which has been on view in the grounds of Aldford House, Park Lane, London, W., is the electrical installation. This includes three 100 c.p. lamps, and other smaller lamps in the interior of the theatre, together with two electrical fans, and on the outside Bleriot head lamps, side lamps, and tail lamp. The current is supplied by a Bleriot 12-volt 200-watt dynamo, which is driven by the engine, and gives 15 amperes when the vehicle is running at 12 miles an hour and 25 amperes when stationary. The construction has been carried out under the supervision of Mr. J. N. Walford, who is to be congratulated on its success.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published August 31st, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

11,325/15. **Submarine Sound Detection.** F. VAN ESBROECK and C. CRANSTON. An apparatus for subaqueous sounds such as those indicating the approach of a submarine, consisting of a submerged air-containing bell, in which the vibrations communicated to the air in the vessel are directly conveyed through a sound concentrating device, including a horn with its mouth directed towards the longitudinal waves of sound within the vessel, to the microphone. (Nine figures.)

11,544/15. **Incandescent Lamps.** B.T.-H. Co. (*G.E. Co., U.S.A.*). A process for applying in the form of a thin layer on the tungsten filament itself certain chemicals, the presence of the vapour of which prevents blackening of the bulb. By this means a very much smaller quantity of these materials is required than when, as is commonly done, they are painted on to the filament support.

5,398/16 (*101,067*). **Insulating Material.** E. SOBERG and J. ANDERSEN. An insulating composition consisting of pulverised silica or magnesia prepared from Norwegian talc potstone, with a binder such as dissolved resin.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: RAILING and ANGOLD [Arc lamps] 16,695/15.

Dynamos, Motors, and Transformers: NEULAND [Dynamos] 11,935/15; RHODES and FIRTH [Driving and controlling of generators] 11,974/15; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Motor control] 12,868/15.

Ignition: VAN DEVENTER [Ignition apparatus] 13,815/15.

Instruments and Meters: PALMER, DENHAM, and FERRANTI [Moving coil instruments] 12,314/15; JOHN and JOHN [Earth detector] 17,901/15.

Switchgear, Fuses, and Fittings: HOLM HANSEN [Electric regulator] 11,690/15; REID-LETHBRIDGE [Flasher] 11,981/15; IGRANIC ELECTRIC Co. (*Cutler-Hammer Mfg. Co.*) [Controllers] 1,374/16 (*101,103*); A. FANTINI [Cut-out] 1,483/16 (*101,104*); SIEMENS & HALSKE A.G. [Relays] 6,541/16 (*100,732*).

Telephony and Telegraphy: RELAY AUTOMATIC TELEPHONE Co., WARD, BRYANT, and INMAN [Telephone systems] 11,600/15; RELAY AUTOMATIC TELEPHONE Co. and INMAN [Telephone systems] 11,655/15.

Traction: JERN [Traction motor mounting] 14,768/15.

Miscellaneous: MAITRE and MARTIN [Electromagnetic means for vibrating piano-strings] 7,336/14; B.T.-H. Co. (*G.E. Co., U.S.A.*) [Ship propulsion] 12,361/15; BENITEZ [Generation of current] 14,311/15; BAJMA-RIVA [Connectors] 14,436/15; C. VAN DEVENTER [Discharging electricity from a moving cinematograph film] 6,696/15 (*100,487*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Distributing Systems, &c.: W. H. COLE [Distribution] 11,125/16 (*101,151*).

Dynamos, &c.: A. E. G. [Electrical machines] 11,437/15 (*101,158*).

Telegraphy and Telephony: J. BETHENOD and E. GIRARDEAU [Wireless telegraphy and telephony] 10,576/16 (*101,148*).

Miscellaneous: C. E. CAMPBELL [X-ray apparatus] 6,483/16 (*101,143*).

Amendment allowed

22,549/14. **Telephony.** C. B. KERSTING. This specification, which deals with an intercommunication telephone system employing automatic selector switches, has been amended in order to "limit definitely the ambit of the claims."

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

20,084/02. **Electrolysis.** W. E. EVANS (*Elektrochemische Werke G. m. b-H.*). An electrolytic method of obtaining calcium from fused chlorides or other haloids, which are kept hot in the electrolytic cell by current through carbon rods. A large anode is used with a small cathode.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: E. S. A. COLE, P. A. GRAVEN, and W. GEIPEL [Cables insulated by paper or tape impregnated with bituminous compounds] 10,535/08.

Traction: J. S. BURN and SYLVERLYTE ELECTRIC LAMP Co. [Motor-car lamps] 10,696/08.

Miscellaneous: B. T.-H. Co. (*G.E. Co., U.S.A.*) [Large metal-cased mercury vapour rectifiers] 11,539/09; G. MACHET [Temperature regulators] 16,849/09.

ELECTRIC TRACTION NOTES

Mr. H. Mozley, the Tramways Manager at Burnley, has submitted the following statement of sums which he considers necessary to set aside annually for depreciation :—Rails, value £86,796, annual depreciation £2,787; paving, £43,770—£845; overhead, £15,549—£331; depot buildings, rails, etc., £44,061—£185; general offices, £3,000—£13; centre offices, £5,166—£22; waiting rooms, etc., £407—£7; machinery, £2,800—£50; tower wagon, £642—£32; rolling stock, £54,647—£1,399. The total value is £257,213, and the total annual depreciation £5,672.

The Portsmouth Corporation Tramways accounts last year show a net profit of £31,345 after taking into account £3,000 reserved last year for a certain street improvement which has been deferred until after the war, and £6,568 brought forward. Allowing for capital charges and contributing £13,000 to relief of rates, £2,006 towards items of the nature of capital expenditure, and £3,000 for the improvement, there is a balance of £4,278 carried forward.

The Institution Wiring Rules.—Section 66 of the Institution of Electrical Engineers' Wiring Rules, dealing with encased wiring, is the subject of a note in the September issue of *The Electrical Contractor*. It is stated that one of the members of the Electrical Contractors' Association has received a definite pronouncement to the effect that lead-covered wire must not be used unprotected out of sight. The rule qualifies that conductors "efficiently armoured with steel armouring or cased with brass, copper, or equally hard metal of substantial thickness," may be used without conduits or wood casing; but it has now been definitely stated that a lead-covered wire does not come under this heading. The reason, however, says our contemporary, is not altogether apparent, and it would be interesting to know exactly what considerations have prompted this official ban on the lead-covered wire. Such a protection, of course, is not "equally hard" to brass or copper; but in view of the fact that both brass and copper-covered cable can be most easily pierced—by a stray or thoughtlessly driven nail, for example—the distinction that has been drawn would appear to rest upon rather insecure foundations. At any rate, it would be extremely interesting to hear the official arguments that prompt this objection to lead-covered wire.

War Tribunals.—A contracting electrical engineer at Darwen applied for exemption for an assistant who has sole charge of a motor plant at his works. He informed the Tribunal that half his staff had already joined the Forces, and further depletions would necessitate closing his business. Conditional exemption was granted, but an application for an apprentice in charge of an electrical plant in a colliery by the same employer was dismissed. At Bexhill last week a wiring contractor appealed for one of his employees who was, he said, the only man in his employ capable of repairing motors. The Chairman of the Tribunal suggested that motors were not very difficult things to keep in repair, and that his own particular motors were looked after by a boy of 17, who had learned to do the work in a month. The Tribunal refused to grant any exemption. The Bath Tribunal has refused further exemption for the electrical engineer at the local Palace Theatre.

LOCAL NOTES

Aberdeen: *Electricity Accounts.*—The number of units sold last year was 15 millions, this figure exceeding the previous year's output by 2½ millions. Coal has cost £8,992 more than in the previous twelve months and formed the principal item of the £11,268 increase in the total cost of production. There was a net profit of £8,792 after meeting capital charges for the year, this figure being £4,157 higher than in the previous twelve months. It will thus be seen that the year has been one of exceptional progress for Aberdeen for a time when the staff has been reduced to a minimum, and the difficulties of obtaining supplies, etc., have been at a maximum.

Eastbourne: *Increased Charges.*—A report has been submitted by the borough accountant upon the finances of the electric supply undertaking, in which he says that in spite of the last increase in the price for lighting, the income for 1915-16 remained practically the same as in the previous year. The Council is therefore recommended to increase the charges for lighting by a further ½d. per unit from October 1.

Guildford: *Supply Company's Accounts.*—The Guildford Electric Supply Co.'s accounts for 1915 show a net profit of £222 after meeting considerable expenditure upon renewal of distributors, feeders, and pilot cables. This net profit is after meeting debenture interest, interest on temporary loans, and dividends on the Preference shares.

Shipley: *Linking-up with Bradford.*—A short time ago we mentioned that the Shipley and Bradford Corporations had held a conference with the object of seeing if steps could be taken to link up their respective electricity undertakings in accordance with the circular letter of the Board of Trade in May. The Shipley borough electrical engineer has now reported that as only a comparatively small saving would be effected in coal consumption by such an arrangement, and, furthermore, that there were serious disadvantages in the scheme, he recommended that no further action should be taken in the matter. The Sub-Committee which had the matter in hand has adopted this view, and at the last meeting of the Electricity Committee it was suggested that a communication to this effect should be addressed to the Bradford Corporation. During the course of the discussion, however, it was pointed out that as the Bradford Corporation approached the Shipley Corporation practically at the request of the Board of Trade, it would only be courteous if a further meeting was held with the Bradford Committee, and this course was adopted.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

New Zealand.—The Palmerston Council proposes to spend £20,000 on electric lighting installations.

The Gisborne Borough Council requires a cooling tower at its electricity works. The specification may be consulted at 73, Basinghall Street, E.C.

Walthamstow: The Local Government Board has sanctioned a loan of £9,610 for new generating plant.

Miscellaneous

London.—*H.M. Office of Works.*—A supply of incandescent electric lamps is required. Further particulars from the Controller of Supplies, H.M. Office of Works, King Charles Street, S.W., and tenders to Secretary, H.M. Office of Works, Storey's Gate, S.W., by September 8th.

L.C.C.—The Asylums and Mental Deficiency Committee require a twelve months' supply of electric lamps. Clerk, 2, Savoy Hill, Victoria Embankment, W.C., September 15th.

New Zealand.—The Palmerston Council proposes to spend £66,000 on a trolley tramway system.

Warrington: The Warrington Guardians require a six months' supply of electrical goods for the workhouse and cottage homes. Separate tenders are required. Clerk.

Wolverhampton: A steel crane gantry and steel roofing are required for the electricity works. Borough Electrical Engineer, September 8th.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith and Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £129 to £131 (last week £128 to £130).

Liquidations.—A meeting of the Phœnix Electric Heating Co. (1914), Ltd., will be held on October 2nd at 3 p.m. at 8, Staple Inn, Holborn, to receive the liquidator's account of the winding-up.

The Electrical Oil Refining Co., 29, Great St. Helens, E.C., is to be wound up voluntarily. Mr. J. E. Frost is liquidator. A meeting of creditors will be held at the above address on Friday next at 7 p.m.

Bankruptcy.—A first and final dividend of 2s. 8½d. in the £ is announced in the bankruptcy of W. D. Birkett, factor of electrical goods, Windsor Avenue, Whitley Bay, Northumberland. The amount is payable at the Official Receiver's Office, 30, Mosley Street, Newcastle-upon-Tyne.

Italian Agency.—The *Board of Trade Journal* states that an engineer with offices at Cagliari and Rome wishes to act as agent for United Kingdom manufacturers of electrical, scientific, and telephonic apparatus. Further particulars from the British Chamber of Commerce for Italy, 7, Via Carlo Felice, Genoa.

Trade in Australia.—A company has been formed in Sydney for the purpose of carrying stocks and securing agencies for United Kingdom manufacturers of power plant and machinery of every description. According to the *Board of Trade Journal*, the principal shareholders are understood to be associated with the various local industries for which engineering supplies are required, and the prospective manager has been engaged for some years in the engineering trade in Sydney and has a good knowledge of local requirements. British firms can obtain the name and address of the company at 73, Basinghall Street, E.C., where further particulars can be obtained.

APPOINTMENTS AND PERSONAL NOTES

Mr. J. Boyce, the borough electrical engineer at Todmorden, has been granted an increase in his salary of £25 per annum.

Captain J. A. Rutherford, of whose death official information has now been received, was before the war in the service of the Rangoon Electric Tramway and Supply Co.

Mr. D. H. Davies, chief assistant electrical engineer at Stockton-on-Tees, has been appointed borough electrical engineer and tramways manager at Heywood in succession to Mr R. B. Leach, recently appointed to Loughborough. The salary is £200 per annum. There were 50 applicants for the post.

Mr. J. N. Stephens (manager of the Wiring Supplies Department of the British Thomson-Houston Co.) has joined the Royal Flying Corps as second lieutenant (Asst. Equipment Officer).

Mr. E. J. Fox is resigning the position of London manager of Messrs. Stewarts and Lloyds, Ltd., in order to take up the position of general manager of The Stanton Iron Works Co., Ltd., near Nottingham, with a seat on the board as managing director. Mr. Fox succeeds in March next Mr. J. A. Longden, whose services will, however, be available to the company, as he remains a member of the board of directors.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Newcastle-upon-Tyne Electric Supply Co.—An interim dividend of 2½ per cent., less tax, is declared on the ordinary shares. This is the same as last year.

ELECTRICAL ENGINEERING

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SUMMARY

THE 1916 meeting of the British Association, which concluded at Newcastle on Saturday, was notable for the attention given to problems affecting the future development of Great Britain which has arisen out of the war. One such was the question of fuel economy, with which electrical power distribution is closely allied. A whole day was given up to a discussion of the report of the Fuel Economy Committee, and many leading men in the electrical industry took part. Opinion is more and more strongly favouring the desirability of eliminating by some means the burning of raw coal and utilising gas for steam raising, at the same time recovering the bye-products with a view to establishing the chemical industry in this country on a sound basis. —In his Presidental Address to Section G (Engineering), Mr. G. G. Stoney discussed the need for closer working between employers and employees.—In a Paper dealing with the work of the Engineering Standards Committee, the new Secretary, Mr. C. Le Maistre, dealt at length with the electrical side of the Committee's activities and made the interesting announcement that arrangements are being made to translate the various specifications into French and Spanish, and possibly into Russian.—In a Paper on the influence of pressure on gaseous ignition, Dr. Thornton considered the igniting power of various kinds of sparks, and showed that a change in barometer from 28 in. to 30 in. increases inflammability by impulsive sparks, though not by condenser or circuit-break sparks.—Professor Howe dealt with the calculation of the capacity of radio-telegraph antennæ, and showed that, even for aerials of complicated design, it is a relatively simple matter to predetermine the capacity and to calculate the effects of the earth, masts, or buildings, in close proximity to the aerial.—"Some characteristic curves of a Poulsen arc generator" is the title of a paper describing an experimental research into the properties of the hydrogen immersed carbon-copper arc shunted by an oscillating circuit (pp. 348-352).

THE size of condenser necessary for damping the spark caused by opening a key in a circuit is discussed in our Questions and Answers columns (p. 352).

THE Shareholders Committee appointed to enquire into the position of the Metropolitan Electric Supply Co. has now reported. An amicable arrangement has been come to with the present board under which Mr. W. Harrison Cripps, the chairman, resigns but remains on the Board, and is succeeded by Mr. A. W. Tait. Two other new directors are added. High praise is given to the work of Mr. J. S. Highfield, whose services it is recommended should be retained (p. 353).

A WORKSHOP for the training of partially disabled soldiers in electrical engineering and other subjects has been provided by Queen Mary at Brighton (p. 353).

AMONG the subjects on specifications published at the Patent Office last Thursday were alternators, electrical ship propulsion, motor control, and discharging electricity from cinematograph films (p. 354).

ATTENTION is called to the Board of Trade regulations regarding overhead transmission lines (p. 354).

THE Ilkeston Corporation Electricity & Tramways undertakings are to be sold (p. 355).

A 3,000-kw. turbo-alternator is required at Swansea, and 50,000 yellow flame arc carbons by the Victoria Railway Commissioners (p. 355).

1st LONDON ENGINEER VOLUNTEERS

ORDERS FOR THE WEEK, BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE.

Officer for the Week.—Platoon Commander N. E. Brown.
Next for Duty.—Platoon Commander C. H. C. Bond.
Resignation.—Major T. F. Hobson resigns his appointment as Sub-Commandant (dated Sept. 4th).
Appointment.—Sapper T. Baseden to be Quarter-Master Sergeant (dated Sept. 8th.)
Monday, Sept. 18th.—Technical for Platoon No. 9, Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits Drill, 6.25—8.25.
Tuesday, Sept. 19th.—Range Practice.
Wednesday, Sept. 20th.—Lecture, 7.15. Lecture, W. Eyles, Esq. (late R.E.), 7.15. "Demolitions." Platoon Drill, Platoon No. 1. Range Practice.
Thursday, Sept. 21st.—Instruction Class, 5.45. Platoon Drill, Platoon No. 5. Range Practice.

THE INSTITUTION AND THE INDUSTRY

THE proposals of the Institution of Electrical Engineers to the Electrical Trades Committee of the Board of Trade (ELECTRICAL ENGINEERING, July 13, p. 268), were the subject of an outspoken article in the *Financial News* a few days ago, having special reference to the suggestion that the electricity supply of the country should be placed under Government control. We reproduce our contemporary's remarks below with the comment that we believe the intention behind the suggestion of the Institution is some form of control which will prevent the duplication of power-stations of small size throughout the country, and bring about uniformity of system of supply, &c. Municipalities and companies are concerned, and the position in London is the best example of confusion in this respect that can be imagined.

Our contemporary says:—

A certain danger threatens the interests of shareholders in electricity supply companies, which it would be well for them to realise; it is the recommendation which is to be made by the Institution of Electrical Engineers to the Electrical Trades Committee of the Board of Trade that electricity supply undertakings should be placed under Government control. The position is the more serious since the engineers and many other members of the staffs of the London companies are members of the Institution, and their not having dissociated themselves from this suggestion naturally means that the Committee will assume that it is thus supported by officials, if not by the Companies themselves. Now, Government control cannot but affect the profits of the undertaking; in fact, it might lead even to a form of confiscation, very seriously depreciating the value of such investments. An example of the danger can be seen in the case of the Hydro-Electric Commission of Ontario. A serious situation has arisen by the sudden development of this body from a formal controlling committee into an arbitrary body armed with newly-passed legislative powers which will enable them almost to eliminate private enterprise at will. A precisely similar danger threatens shareholders in London companies, and they would be well advised to communicate at once with the Boards of the companies in which they are interested, and insist on being assured that the companies are taking steps to dissociate themselves from such a proposal, and protest in the proper quarters against any form of Government control.

The position is not altogether easy to understand. It is stated that the Electrical Trades Committee is composed almost wholly of members of the Institution of Electrical Engineers; if so, recommendations are being made to its own members. The Institution is a heterogeneous body, and it is questionable if all concerned have been consulted. Should the control pass as suggested, it is quite certain that the Government would not find money to assist the development of the industry. Consequently, shareholders would have to put up funds in the utilisation of which they would have no voice whatever.

THE BRITISH ASSOCIATION

ALTHOUGH the 1916 meeting of the British Association, which was held at Newcastle from Tuesday to Saturday last week, probably constitutes a record in the smallness of the attendance, for reasons which need not be explained, nevertheless the main subjects of discussion were of the utmost importance and are calculated to have a vast influence upon the future of the country after the war. We give below abstracts of those papers and discussions which more directly interest our readers, and special attention is directed to the discussion on Fuel Economy, to which five hours were devoted on Friday.

Sir Charles Parsons, F.R.S., has been elected President of the meeting next year, which will be held in Bournemouth. An invitation to hold the meeting in 1918 at Cardiff has been accepted.

SECTION G (ENGINEERING)

PRESIDENTIAL ADDRESS

Mr. Stoney dwelt in his address on the way in which our engineering and allied industries have been handicapped by the reluctance of firms in the past to utilise highly educated labour and to adopt scientific methods. How many firms, he asked, had a skilled chemist on their staffs? This was a matter of great importance in regard to reception tests of materials. Another direction in which scientific labour was invaluable was in seeing that instruments are in proper order and tests accurately carried out. Many engine tests, for example, were unreliable, owing to neglect of this kind. Closely allied to such work in engineering works was the general question of scientific research, and here a trained scientific mind was of the utmost importance to see that reliable results were obtained, and to make true logical deductions from these results. The research work being done in engineering colleges and at the National Physical Laboratory was worthy of great credit, but the financial support available in both cases was totally inadequate and infinitesimal in proportion to the Government funds hitherto provided for such purposes in Germany. Investigations in engineering shops did not meet every case. The question of finance was apt to prevent the subject being really thrashed out to the bottom.

It was not only on the scientific side, he said, that there was so much to be done in the way of putting our house in order; there was much to be done in the way of putting the management and commercial sides of engineering and other allied works in a position to compete. He was of the opinion that the great growth of engineering works and their being formed into limited liability companies had not been without its drawbacks. In the old days an engineering works was comparatively small, and as a rule one man, generally a clever engineer, was at the head. After his death, or often before, the place was turned into a limited liability company, and gradually fell into the hands of a body of men, many of them not technical, who had no further interest in the firm than to draw their salaries beyond the few shares necessary to qualify them as directors.

The speaker then went into some aspects of the labour question. Taking the average capital expended in an engineering works per individual employed as £200, he pointed out that (at 4 per cent.) the shareholders got about £8 per year per individual employed. The worker got eight or nine times as much (about £70 on an average), which showed on what a small margin the capitalist worked. And without the capitalist, there would be no factories erected and no work for the working man. Also, without profits the capitalist will not invest in this country, but will seek a field elsewhere. Every £200 invested in this country in a factory means work and livelihood for one British working man. He did not think that, as a whole, employers looked after their workmen as they might.

The adjustment of wages to be paid to workmen was a most difficult question. Time rates did not differentiate sufficiently between skilled and unskilled work, and the fixing of piece-work prices was most difficult. The practice of cutting prices by the masters in the past was, in his opinion, largely responsible for the present limitation of output by the men about which we hear so much. There was, he continued, a rule that if a man made more than time and a half or time and a third, the price of the job was to be cut. If the price had been fairly fixed, why should it be reduced because the man made large wages due to his skill and industry? The larger the output from his vice or lathe, the better for the master, as he was getting a larger output from his plant with a certain capital expenditure, and thereby establishment charges are reduced. It was obviously more important to get large output than to pay small wages. A fair bonus system was perhaps the ideal system, but here, again, there were difficulties regarding alterations in the rates. Gradually the pernicious doctrine had been set up that the less work done by a man the more employment there would be, it not being seen that the cheaper an article can be produced, the larger will be the sale for it, and the better it will be able to compete with foreign products. Unless something could be done, he said, to bring master and man together and to make both work for the common good, English trade must inevitably go down, and the supremacy England has in the engineering of the world will come to an end. Nothing, he continued, was ever a truer statement than that recently made by Lord Joicey, that this country, unless it produces as cheap or cheaper than other countries, cannot, in the long run, keep her trade, and this is true, in spite of any tariff walls which may be set up; and if the present state of affairs is maintained of unscientific management and obsolete machinery, combined with limitation of output and high wages, or, in other words, high cost of production, we must, sooner or later, go to the wall.

Other subjects dealt with briefly in the address included the position of the grades of officials, from the manager down to the foreman, between the masters and the men; the desirability for combination among employers, as well as among employed; the standardisation of engineering specifications; and, lastly, the need for improvement in our educational system. It was little short of a disgrace, he said, that the older universities were closed to those without a knowledge of Latin and Greek.

On Thursday Section G met both in the morning and afternoon, and a number of papers were read and discussed, although the discussions were of brief duration:—

STANDARDISATION AND ITS ASSISTANCE TO THE ENGINEERING INDUSTRIES

In this Paper Mr. C. Le Maistre, Secretary of the Engineering Standards Committee, after relating the circumstances in which the Committee came to be formed, and its method of working, went on to speak of the success of the movement towards a greater degree of standardisation.

Turning to the electrical side of the Committee's activities, it is interesting to note the large amount of preparatory work of importance which has been successfully carried through during the past two years. The most important electrical work completed is that of the Standardisation Rules for Electrical Machinery, in the preparation of which the Committee has received the cordial co-operation of the British manufacturers through their official organisation.

The conditions of the electrical industry in this country are very different from those existing in Germany or America. In the United States two large Corporations deal with practically the whole of the business, whereas here there are some 40 or 50 firms more or less in competition with one another. However, conferences held both in London and in New York with the Standards Committee of the American Institute of Electrical Engineers have resulted in the establishment of a thoroughly practical basis for the comparison of tenders for electrical machinery made in the United States of America or Great Britain, the rules of both countries being now in agreement on all essentials.

Much also has been accomplished in one of the most difficult of tasks, the standardisation of small electric fittings with due regard to liberty of design. This work, in which again the makers' association has been most helpful, has occupied a great deal of time, and the difficulties and prejudices to be overcome have been great. Ordinary household wall plugs and sockets have at last been standardised as regards interchangeability. A specification to secure interchangeability between any charging plug and any socket of the type recommended by the Electrical Vehicle Committee of the Incorporated Municipal Electrical Association should be of material assistance in promoting the use of electric wagons and runabouts. A specification for electric supply meters has recently been evolved after much labour, and although some modifications may still be required, it is hoped that it may be eventually proved satisfactory to both producer and purchaser alike. A system of British Standard graphical symbols for use in electrical engineering plans is being drawn up, and in this work the Committee has the co-operation of the American and Canadian Electrotechnical Committees.

The ramifications of the Committee, as will be seen from the cases cited, are extremely widespread, and the commerce of the world, due to the increasing ease of communication, being largely international, one might almost say, in spite of the artificial barriers set up by different nations, it is natural that the Committee should be forced to envisage co-operating internationally. The Sectional Electrical Committee, with a different chairman, is, *ipso facto*, the British Committee of the Inter-

national Electrotechnical Commission, which has branch Committees in 15 to 20 different countries.

The complex nature of electrical machinery calls for different treatment, from the point of view of standardisation, than in the case of other engineering materials. Indeed, the problem of the rating of electrical machinery is, possibly, more intricate than is the standardisation of any simple pieces of mechanism, electrical or otherwise. The conductivity of the copper, the permeability of the iron, the mechanical strength of the materials, can be estimated with sufficient accuracy from the results of definite and easily carried out tests on samples. When the question of insulating materials, however, is considered, the problem is, of course, very different, and one can but acknowledge that, owing to their inherent properties, the insulating materials employed at present come into an entirely different category. They are governed by no well-defined laws, as in the case of the copper and iron, their properties are variable and alter largely for very small changes in the conditions of manufacture, as well as those under which they are employed in the completed machine. One of the important problems, therefore, is the settling of the limits which it is considered necessary to impose in order to ensure that the principal causes of destruction of the insulating materials, the heating combined with the time element, shall be well kept within safe limits.

A clear distinction exists also between an international standard of quality" and an "international rating." The international acceptance of the former has already been brought about by the adoption, by the I.E.C., at its Berlin meeting in September, 1913, of certain limits of observable temperature applying to the materials in general use to-day. But these limits do not offer a means of comparing directly machines from various sources, since they would not necessarily have the same temperature rise. The fact, however, that American and British electrical engineers are at one on this point of immense commercial importance will doubtless have a great influence on the electrical industry of the world.

On all sides there are signs of strenuous preparations for meeting conditions after the war; science and industry are coming closer together, the commercial and technical sides inseparably linked together are being more efficiently organised, research work to assist manufacturers is being co-ordinated, finance is organising, combinations of commercial organisations are in the air; in fact, everything is being done with a view to strengthen British industry. The German League of Economic Associations recently formed out of the six great Associations of German engineers, architects, furnace men, chemists, electricians, and marine engineers, numbering, so it is said, some 60,000 members, is an indication of what may be expected. Every effort must, therefore, be made to ensure that the British Standard Specifications are readily available to foreign purchasers as well as to those in the British Empire. A few of the specifications have already been translated into French, and it is hoped that satisfactory arrangements may be made to translate them all, both into French as well as Spanish. In regard to Russian, the question is somewhat complicated, but in this case also the matter is being given the most careful consideration.

Discussion.

Mr. C. H. Merz expressed the hope that the specifications would be available at a reasonable price when they were translated. At present the price was considerable, and he did not see why they should not be available in foreign countries for a few francs or a shilling or so each. The advertisement value would be enormous. Speaking with regard to the electrical industry, it was impossible to praise too highly the work done by the Committee. The electrical trade was one of the youngest in the world, and it had suffered enormously in this country from want of standardisation. It had been said that standardisation could be carried too far, and that it might stop progress. The very reverse was the case in the British electrical trade, and he hoped further standardisation would result in a reduction of the number of manufacturers, which would be in the interests of the trade and the purchaser alike. It was almost too ridiculous to think that there were 40 or 50 makers of standard sizes of motor, and many of them turning out twos and threes. The increased cost of manufacture under such a system must be very great. With regard to the work of the Admiralty, Mr. C. H. Wordingham, as head of the Admiralty important electrical work, had fallen in with the work of the Committee absolutely, whereas he might have taken a high-handed position, whilst the work of Dr. Glazebrook, as Chairman of many of the Committees, had been invaluable to the engineering industry.

Mr. C. Le Maistre, replying, agreed that it would be of great value if the publications of the Committee were available at cheaper prices than at present, but although he could not hold out much hope just now, the matter would be considered. It was very important that the specifications should be available in foreign countries, because the whole of the American specifications were to be translated into Spanish and other languages, and would be sold at 25 cents, and we must not be behind the Americans.

THE INFLUENCE OF PRESSURE ON THE ELECTRICAL IGNITION OF METHANE

Dr. W. M. Thornton explained in a lengthy Paper that his experiments on the influence of pressure on gaseous ignition were made with methane (CH_4), because of its extreme practical importance, and of its relative inertness. This is the lightest and simplest of the paraffin series of hydrocarbons, having a density 0·55 that of air; it was used in a 9·5 per cent. mixture in air, which just gives perfect combustion. There are four kinds of single spark which may be used for experimental ignition, each of which has characteristic features, and all but one of which is in practical use. These are: (1) a transient electromagnetic impulse; (2) the discharge of a condenser placed across the gap; (3) the short arc formed at the point of breaking a continuous current circuit; (4) the same with alternating current. The last two differ so much in some of their effects that they have been examined separately. In each of these groups there are sparks which do not ignite the most inflammable mixtures of highly combustible gases and air.

Considering first ignition by impulsive coil-discharge, it is shown that the least igniting spark varies with the pressure, the curve connecting the two having a stepped form. The precise origin of these steps is obscure, but there is little doubt they are examples of selective action which occurs at certain frequencies of collision between the molecules of combustible gas and oxygen. The pressure most favourable to ignition by impulsive sparks is shown to be between two and three atmospheres absolute.

Ignition by condenser discharge differs from the above in two important features. (1) The best igniting spark is *independent of the pressure* from the lower limit at half an atmosphere to just above one atmosphere. (2) As the pressure is raised ignition becomes *easier*, and there are steps in the curve, but now down, as 30 lb., 60 lb., and 85 lb. per sq. in. are approached. Electromagnetic jump sparks and condenser discharge, therefore, proceed in opposite directions, one becoming easier as the pressure in raised, the other more difficult.

The experiments on ignition by continuous-current circuit break sparks showed that below atmospheric pressure the least igniting current increases, so that the product of the current and pressure is approximately constant, until at half an atmosphere there is a sudden and most remarkable increase of inflammability. The simplest explanation of this is that it is a continuation of the selective action which gives rise to the steps at higher pressures. Every gas examined, that is, hydrogen, methane, ethane, propane, carbon monoxide, and coal gas, exhibits this effect; in hydrogen it is so great that at the dip the igniting current falls almost to zero, the mixture being that for perfect combustion. If, however, the break of circuit is made slowly the dip is entirely wiped out, and the curve is hyperbolic. Continuous-current spark ignition is therefore midway between impulsive and condenser ignition; that is, it is not a simple energy effect, for this would cause a falling curve with or without steps, nor does it work by ionisation alone. It would appear to be a very fair mean between ionic and thermal ignition.

With regard to ignition by alternating-current break sparks, this, at the lower pressures, follows the type of continuous-current slow-speed ignition; that is, the thermal action of the spark predominates, and at the higher pressures it remains nearly constant up to pressures approaching 80 lb. per sq. in., when it suddenly becomes easier.

In summarising his Paper, Dr. Thornton said that the influence of small changes of gas pressure upon electrical ignition is important in coal mining. Apart from the effect of pressure on the presence of gas or the dryness of the mine, a change from a low barometer of 28 in. to a normal 30 in. somewhat increases inflammability by impulsive sparks, but has little effect on that by condenser or circuit-break sparks. The compression of an explosive mixture increases its inflammability by condenser sparks, and lowers it when the sparks are impulsive. Circuit break sparks have the same igniting power over a long range of pressure. In every case there are mixtures in which ignition is abnormal, giving rise to steps or sudden changes in the form of the curves of observations.

THE CALCULATION OF THE CAPACITY OF RADIO-TELEGRAPH ANTENNAE, INCLUDING THE EFFECTS OF MASTS AND BUILDINGS

The calculation of the capacity of radio-telegraph antennæ, except in the simplest cases, was until quite recently looked upon as an impossibility, and one of the leading text-books on the subject stated that "In the case of multiple-wire aerials the only way to determine the capacity is to measure it." This is no longer the case, and it is shown in this Paper by Prof. G. W. O. Howe that, even for aerials of complicated design, it is a relatively simple matter to predetermine the capacity and to calculate the

effects of the earth, the masts, and anything else in close proximity to the aerial. The accuracy obtainable is more than sufficient for all practical purposes. The principle of the method employed by the author has previously been described, and in the present Paper the method is extended and applied to a number of concrete examples. Some tests are also described, the results of which indicate the accuracy of the calculated values.

The principle of the method is briefly as follows:—It is assumed that the charge is uniformly distributed over the surface of the whole antenna, and the average potential of the antenna under this fictitious condition is then calculated. Formulæ have been worked out by means of which the average potential can be easily determined, even in the case of complicated antennæ. The assumption is then made that this average potential differs but little from the actual potential which the antenna would have at every point if the same total charge were no longer uniformly distributed, but allowed to have its own natural distribution.

In the original Paper, read before the British Association at Sydney, formulæ and curves were given for flat, multiple-wire antennæ with any number of wires from 1 to 12, and also for 4-wire aerials, with the four wires at the corners of a square. Formulæ and curves were also given for wires meeting at various angles, and the effect of the earth on both horizontal and vertical wires was considered. In September, 1915, the author published formulæ and curves by means of which aerials of the umbrella type can be readily calculated. In his "Principles of Electric Wave Telegraphy," Prof. Fleming gives a number of measured capacities of actual aerials of various types to serve as a guide in estimating the capacity of any other aerial. Some of these measured values agree fairly well with the calculated values, but others show a wide divergence; it was in seeking to explain these discrepancies that the author was led to devise a method of calculating the effect of masts and buildings. His previous curves and formulæ are extended so as to include a multiple antenna of 25 wires.

After giving several examples of his method, Prof. Howe makes an approximate calculation of the effect of the Eiffel Tower on the capacity of the antenna which is supported from it. By calculation carried out only approximately upon very meagre data, he arrives at the value $7{,}540 \times 10^{-6}$ mfd. and the actual measured capacity has been given as $7{,}300 \times 10^{-6}$ mfd. In some tests made by the author to determine the accuracy which one might expect, the difference between the calculated and measured values proved to be less than four per cent.

THE POULSEN ARC

In a Paper entitled "Some Characteristic Curves of a Poulsen Arc Generator," Mr. N. W. McLachlan described an experimental research into the properties of the hydrogen immersed carbon-copper arc shunted by an oscillating circuit, particularly with reference to the conditions for which the shunt current is a maximum. The following conclusions were arrived at:—

With fixed capacity and frequency there is a certain resistance giving maximum power absorbed in the shunt circuit, and a certain higher resistance at which the efficiency is a maximum. With fixed capacity and resistance in the shunt circuit there is a certain inductance and frequency for which the power obtained from oscillations of fundamental frequency is a maximum. With given resistance and frequency, the power obtainable in the shunt circuit and the efficiency of the arc increase with the capacity, but with larger capacities the burning, especially with small inductances, is apt to be irregular and noisy. When the power absorbed in the shunt circuit is very small, the capacity being fixed and not exceeding a certain limit, there is a certain inductance and frequency for which the shunt current is a maximum. A diminution in the strength of the magnetic blast does not cause any appreciable alteration in the maximum power and efficiency. The maximum power occurs at a lower frequency, and more power is obtainable at lower frequencies than with a stronger blast. A diminution in the strength of the magnetic blast does not cause any appreciable alteration in the fundamental frequency of the oscillations in the shunt circuit; but there is a tendency for the second harmonic to increase with capacities above a certain value. The second is the most prominent harmonic, and increases with capacity or with frequency. The insertion of resistance in the shunt circuit causes the burning to be less regular than it is without resistance. The irregularity of the burning increases with increase of the resistance.

ENGINEERING PROBLEMS AFTER THE WAR

Among the Committees appointed in 1915 was one to consider engineering problems affecting the future prosperity of the country, and in the ordinary course a report should have been presented to Section G. Mr. G. G. Stoney, the President of the Section, however, announced that the Committee had no report to present, and asked for reappointment for the coming year.

FUEL ECONOMY

The report of the Fuel Economy Committee, which, as already mentioned, was discussed on Friday at a joint meeting of Section B (Chemistry) and Section G (Engineering) sets out the work of organisation which has been carried out during the first year of its existence, it having been appointed for the first time at the Manchester meeting in 1915. The early part of the report is, to a large extent, a repetition of the particulars given in ELECTRICAL ENGINEERING for March 30th, 1916, page 115. The object aimed at is to avoid the burning of any coal whatsoever in a raw state, and to ensure that it is so treated that the whole of the valuable by-products are secured. At the same time it is fully recognised that much work must be done before such a state of affairs is reached, and it is for that reason that the past year has been spent in mapping out the ground which is to be covered by the five Sub-Sections into which the main Committee has been formed. The Sub-Sections are respectively: (a) Chemical and Statistical; (b) Carbonisation; (c) Metallurgical, Ceramic, and Refractory Materials; (d) Power and Steam Raising; (e) Domestic Heating and Smoke Prevention. Our interest, however, lies specially in Section (d), of which the Sub-Committee consists of Mr. C. H. Merz (Chairman), Lord Allerton, Mr. J. A. F. Aspinall, Dr. Dugald Clerk, Mr. S. Z. de Ferranti, Sir Robert Hadfield, Dr. H. S. Hele-Shaw, Mr. W. W. Lackie, Mr. Michael Longridge, Mr. Robert Mond, Sir Charles Parsons, Professor Ripper, Mr. R. P. Sloan, Mr. C. E. Stromeyer, Professor Threlfall, Mr. G. Blake, and Mr. W. B. Woodhouse.

The special duty of this Sub-Committee is to investigate the economies in fuel which would result from the use of improved methods, and it has been decided to deal with the subject under the following heads: (1) To consider (a) the amount of fuel consumed, and (b) the corresponding power developed in the United Kingdom under the following heads: Factories, mines, railways, ships, and steam raising for other purposes than power. (2) To consider the present position of central electrical power plants and gas undertakings as regards power supply. (3) To discuss the relative merits of the present methods for producing power by steam, gas, oil, and petrol engines respectively. (4) To investigate the possible saving of fuel which might be effected (a) by improved plant, (b) by greater centralisation of power production, (c) by co-ordination with metallurgical and other manufacturing processes, (d) by some measure of public control, (e) by better supervision, and (f) by the use of inferior grades of fuel which are at present wasted.

While, on account of the magnitude of the subject and the amount of investigation involved, it has not been possible to submit any report, it may be mentioned that information has been sought as to the amount of fuel consumed and the corresponding power developed in such official publications as the Report of the Royal Commission on Coal Supplies in 1905, the Census of Production for the year 1907, and the Returns published annually by the Home Office for Mines and Quarries, and various Shipping and Customs Reports. But, although from such sources fairly accurate figures can be obtained for the amount of coal used annually for industrial purposes and shipping, the corresponding figures of power produced are not obtainable from any published returns so far as can be ascertained. The average figure of five pounds of coal per horse-power hour, which was given in the Report of the Royal Commission on Coal Supplies in 1905, was, it is believed, deduced from returns from a number of typical industrial concerns where information could be obtained, and it is probable that this estimate did not exaggerate the actual coal consumption per horse-power hour at that time. In view of the impossibility of obtaining accurate returns of fuel consumption per horse-power from the whole of the power users in this country, it has been decided to investigate the matter by asking different districts throughout the country for detailed returns from typical factories in various trades, selected by members of the Sub-Committee who have special knowledge of particular trades. Special memoranda are in course of preparation on questions of organisation of power production for industrial and transport purposes, the use of large turbine and gas engines, and other important aspects of the power question.

DISCUSSION.

The discussion on the report occupied the whole morning and afternoon of Friday, the morning being devoted to the aspects of the report in which, for the moment, we are not specially concerned. The afternoon, however, was taken up almost entirely by a discussion of the possibilities of fuel economy from the point of view of electrical power distribution.

The subject was introduced by Mr. C. H. MERZ, who said that the advantages of dealing with electricity supply for this country as a whole in a comprehensive manner were not generally realised by the industrial community or by the State. The compact nature and relative proximity of our industrial

districts favoured the development of electric power undertakings throughout the country on the lines already adopted on the North-East Coast, such as could lead to economies in coal consumption in the near future of 25 millions, and eventually 50 to 60 million tons of coal per annum. By means of uniform interconnected power distribution, instead of isolated municipal systems, the large prime movers and steady loads and favourable station sites necessary for the highest economy would be realised, and a greater degree of reliability of supply ensured. By suitable co-operation between municipal and power company interests such an ideal, he said, might be achieved in this country, on account of its compact nature, to an extent which is not possible in other countries. Such a system would facilitate the extraction of bye-products of coal by which a large psoportion of the requirements of the country, in the way of manures, crude oils for marine propulsion, and motor spirit for road traction, could be met. The first necessity was a standarisation of supply frequency and voltage, at any rate in each industrial area, and the unification should be done at the nation's cost under control of the Government. Briefly, in addition to the primary advantage of an enormous saving of coal as a result of the erection of plants of the most economical size in the best positions, there were the following advantages obtainable by the wholesale generation and distribution of power over large areas on uniform systems:—

Utilisation of waste heat, of coals and other materials too friable for transport, or of a nature such as will not stand the cost of transport; development of new carbonisation and distillation processes; more general use of electricity for power traction, metallurgical and electro-chemical work, and increased industrial output on account of the lower cost of power.

Mr. R. P. Sloan gave a brief account of the economies already attained in the North-East Coast industrial area in consequence of the development of electric supply on a large scale. The Tyne shipyards and engineering works, he said, had adopted electricity practically to the exclusion of all other forms of motive power; many collieries depended entirely on electricity; an extensive suburban electric railway service had been developed; electric locomotives were used for freight haulage; and electricity had been applied with particular success to drive rolling mills, colliery winders, and for other purposes requiring concentration of a large amount of power on one shaft. New industries had been established because of the cheap power available; extensive utilisation of waste heat and gases had been made, and several small and uneconomical local generating stations had been shut down.

Working over an area of 1,400 sq. miles, with five main stations and a distribution system extending seventy miles north and south, the scheme links up with eleven waste heat stations, and gives a three-phase 20,000-volt supply at 40 cycles. The plant capacity represents one-ninth that of the whole United Kingdom, and the power actually supplied about one-fifth. The system had grown up partly by assimilation of other local undertakings, whose systems were rendered uniform with that of the pioneer company, and its success is due to taking full advantage of the best coal and water facilities available, installing plant of a capacity much in excess of that which any individual manufacturer could adopt, and of catering for all classes of consumers, and thereby securing a diversity of load with a resulting constancy of output, and so utilising the plant installed to the best possible advantage.

Seventy-five to eighty per cent. of the power used by the engineering trades in the district, as distinct from collieries and iron and steel works, and the whole electric traction requirements of the North-Eastern Railway, are supplied from the companies' system, and collieries having an aggregate output of over 20 million tons of coal per annum depend on the power companies for their supply. In connection with the latter, at least 75 per cent. of the coal previously used for power purposes at the pits is now saved. The waste heat stations utilising coke oven gas, blast furnace gas, and exhaust steam from flowing and other engines feed into the main systems, in parallel with the main coal-fired stations, each supplying the maximum amount of energy possible from the waste heat available, while all regulating is done at the main stations, and the total coal saving due to the utilisation of waste heat in the district now amounts to some 150,000 tons per annum.

Mr. W. B. Woodhouse (Yorkshire Electric Power Co.) suggested, as a means of providing funds for the Fuel Committee, a tax on all coal used. Taking 270 million tons as the output per annum, only 30 millions were carbonised, leaving 240 million tons uncarbonised or sent out of the country without extracting their residuals. A penny a ton would produce a million a year, and if an extra penny per ton were imposed each year until 1s. per ton was reached, that would be a very valuable stimulus towards the object they all had in mind. The dearer an article became the more necessary did it become to utilise it economically, and such a tax might eventually bring about the position that all coal would be used at the coalfield. The development of carbonisation, in his opinion, must go hand in hand with power distribution by means of electricity. In the Yorkshire area there were 400 collieries producing over 30 million tons a year, and co-operation between these and the power company would bring about three things: (1) An increase in the amount of coal carbonised; (2) the utilisation of low-grade fuels; and (3) a reduction in the cost of power, not only to the collieries themselves, but to all the power users in the district. An interesting development this year was the co-operation of the Yorkshire Power Co. with works employing the low temperature process of carbonisation which was intended to supply the power company with a large quantity of fuel gas and also to produce a smokeless fuel for domestic purposes. The works were situated on the coalfield, and given a market for a smokeless fuel—and there could be no doubt there was a very large market for a suitable smokeless fuel—and given a market for the oils, the process ought to be successful. Development with other power companies throughout the country had not gone on so rapidly as on the North-East Coast for a variety of reasons. One was, unfortunately, that in the areas of the power companies, there were in existence a number of municipal undertakings. In Yorkshire, with a population of three millions, no fewer than two millions of the inhabitants were in the larger towns, and the company was not permitted to supply in those towns without the consent of the municipality. Some of the municipalities supplied at cheap rates, but there were a very large number of districts where there was no supply at all, or the supply was charged for at very high prices. There was, however, a new spirit abroad, and if co-operation could be brought about there was no doubt that power would not only be produced very much more cheaply and fuel be used more economically, but smoke would be almost entirely eliminated.

Mr. R. Maclaurin gave some particulars of the work which is being carried out with the gas firing of boilers under the auspices of the Glasgow Electricity and Gas Committees. He had been experimenting at Glasgow for the last year or so with several objects in view, but the results justified him in saying that he could return to the boiler 66 to 75 per cent. of the energy of the fuel, whilst the oil and ammonia would bring in a return of 10s. per ton of coal carbonised.

Mr. Merz asked what was the capital expenditure per ton of coal in large plants of the type referred to.

Mr. Maclaurin said he had taken the capital cost and allowed depreciation at the rate of 10 per cent. per annum in the case of his plant, whilst he had also taken the capital cost of steam raising by mechanical stokers, and allowed a lower depreciation. He found that at the end of the year the actual saving would amount to 25 per cent. of the cost of the coal.

Mr. Merz asked for the actual figure of capital cost.

Mr. Maclaurin said the capital cost of a plant for dealing with one ton of coal per hour would be £1,500.

Mr. W. A. Chamen (South Wales Electrical Power Distribution Co.) referred to the efforts now being made by the Incorporated Municipal Electrical Association and the Association of Power Companies to co-operate (Electrical Engineering, Aug. 3rd, p. 297). The Joint Committee had reached a point when it was hoped to be able to take actual steps in the provinces. The generation of electricity was being considered as distinct from its distribution, and the principle was being acted upon that existing rights must be respected and existing areas not interfered with as regards distribution. A scheme had been formed by which the country would be divided into a certain number of areas, and in those areas it was hoped to form committees of engineers particularly interested in the generation of electricity. The Joint Committee believed that to a large extent all necessary powers for linking up existing generating stations were at present available, and unless in very special circumstances it should not be necessary to have to go to Parliament at all. It was hoped to arrange a scheme whereby one station would be shut down for one week, with the exception of taking the peak load and during the week-end, whilst another took all the remaining load, and in the next week the position would be reversed. It was not likely that that result could always be arrived at, but in one particular case it had actually been done. The parties had agreed to generate equal quantities of electricity and to divide the hours of working between them. In addition to the saving of fuel, they would save something worth saving in the matter of labour, because it really meant that only one station was working instead of two, so far as labour was concerned. The Joint Committee desired him to let the public know of this spontaneous move, and he hoped that it would be possible to say a good deal more about it shortly. One thing, perhaps, would require legislation, and that was in the matter of way-leaves for laying cables. At present all electrical undertakings had powers to make agreements with landlords to carry lines across their property, but, nevertheless, the landlord had an absolute veto. Already the Postmaster-General had found it necessary to get compulsory powers of this nature, and if it were necessary for that purpose, it was even more so in the interests of the development of electric supply in this country.

Mr. R. A. Chattock (City Electrical Engineer, Birmingham) said that apparently the greatest economy in coal could be obtained by gasification and the recovery of the bye-products, and it had been demonstrated that it was perfectly possible to run large electrical generating stations by means of gas-fired boilers. Indeed, greater economy in the running of these stations could be obtained by that means than by burning raw

coal. At the same time, it was evident from what had been done that the amount of work involved in handling coal in that way was very much greater than what had to be done at the present time in burning raw coal. A very much larger area of land was necessary, extensive works were required to be put down to distil the coal and recover the bye-products, and, in addition, if it were done on the enormous scale which there was every indication of, every one of these bye-products would represent practically a business in itself, and require an organisation and large staffs. It was hardly fair to ask the electrical industry to take on all these duties in addition to supplying electrical energy, and it seemed to him that the handling of coal in that way should be undertaken by some other body which would primarily be occupied in that only, leaving the generation of electrical energy to the electrical engineers. Such a body would have naturally to work in close touch with electrical engineers, but the businesses would have to be kept distinct as far as finance and operating conditions were concerned. Possibly an association could be formed for handling the coal of the country in this way, consisting of coal owners and users. Indeed, such a body might have statutory powers given to them to handle the coal of the country. If a scheme on these lines could be carried out, then electrical energy could be generated on a vastly greater scale than at present and at enormously lower rates. It had been suggested that large generating stations should be put close to the spot where the coal was produced, but there was one consideration governing that, namely, the necessity for an ample supply of condensing water. In the Midlands they were not very well supplied with rivers, and cooling towers were necessary. The cooling towers at Birmingham were evaporating one million gallons of water per day. The whole supply of water to the city of Birmingham was only about 25 million gallons a day, and that had to be brought mostly from Wales, so that if they imagined large generating stations fifty times the size of the present Birmingham station, which would probably be necessary to supply that area, it was quite possible that the available supply of water in the district would not be sufficient. Therefore, it would be necessary to locate these stations where there was an ample supply of water, and where the best results could be obtained from the generating plant. The cost of transmitting energy from such positions by means of trunk mains would be reduced to a comparatively low figure if a very high electrical pressure was used, and there was no objection to going up to 100,000 volts for transmission purposes. It was difficult, however, to see at the moment how these large generating stations could come into existence within a reasonable period of time. There were two ways. One was the slow process of natural development as in the past, but he did not think that would meet the objects in mind by the Committee, namely, fuel economy. Economy in fuel could be arranged far more quickly by compelling all users of energy to take electricity from these large works, possibly by a tax on coal, as had been suggested by Mr. Woodhouse, or it might be necessary to get Parliament to compel users to take their energy in the form of electricity, the justification for such a course being the proper conservation of the coal supply of the country and the elimination of smoke. In addition to what Mr. Chamen had said, the Institution of Electrical Engineers had appointed a Committee to consider very much the same question, but they were looking at it from a national point of view, and were considering the engineering necessities for centralising the generation of electricity at certain points in the country, and distributing it from these centres throughout the country.

Mr. J. S. Highfield also regarded the question of generation of electricity on a large scale by the use of coal and the treatment of coal in such a way as to obtain bye-products as distinct and separate processes. They resolved themselves into an economical question, which must be worked out by collaboration between chemists and engineers, for it could not be doubted that the extraction of bye-products involved a very large expenditure of money, and it became a question whether it was worth while incurring this expense. He was not at all sure that it was the right policy to look on our coal supplies now as lasting only so many hundred years, and to spend large sums of money in trying to economise, because before that period had elapsed developments might arise which would render all this capital expenditure wasted.

Dr. Dugald Clerk, F.R.S., said that if electrical engineers succeeded in doing all they apparently hoped, it appeared to him that gas engine builders and the gas industry would be wiped out of existence altogether. (Laughter.) If electric power was distributed in the way it had been suggested, obviously it could be supplied very much cheaper than at present, and that would be a national service. The British, however, were essentially a people of compromise, and he believed that it would be found for many years to come there would still be room for both the electrical and gas industries in this country.

It is specially requested that all who can in any way assist the work of the Committee will communicate with Prof. W. A. Bone, F.R.S., Imperial College of Science, South Kensington, who will treat any information given as strictly confidential.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. Replies should reach this office within seven days of the appearance of the question. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to unsuccessful replies. The Editor's decision is final.

QUESTION No. 1,511.

A Canadian hydro-electric power plant includes six alternators with a total capacity of 7,000 kw. The load is highly inductive, and therefore operated at a very poor power factor. State the best method of improving the power factor, considering cost, reliability, space factor, etc. Would it be preferable to fit a machine to each unit, or operate one machine on common bus-bars, all the alternators being in parallel?—W. E. L.

(*Replies must be received not later than first post, Thursday, Sep. 21st.*)

ANSWERS TO No. 1,509.

Explain how the size of a condenser necessary for damping the spark caused by opening a key in a circuit is determined. It is found that on a certain apparatus consisting of lamps absorbing 345 watts at either 100 or 220 volts, a condenser of 2½ microfarads capacity is fitted across the key terminals and for a similar apparatus absorbing only 150 watts a condenser of 0·02 microfarads is fitted. Are these capacities correct, and how will their values be affected if the same lamps are installed on an A.C. circuit of 100 or 220 volts and 50 frequency?—Condenser.

The first award (10s.) is made to E. H. for the following reply:—

The only satisfactory method of determining the best value for the capacity to be connected across a switch is to experiment with different values. One then realises the extent to which the capacity can be varied without appreciable alteration in the arcing, and especially the effect of operating the switch at different rates. Thus with a lamp load of the value in question, it really makes no perceptible difference whether a condenser is inserted or not, if the switch is opened very quickly as in the case of some automatic switches with very light moving systems. On the other hand, with a slow break the presence of a condenser makes all the difference. From a number of tests on the latter type of switch controlling a lamp load that could be varied from about 100 watts to 1 kw., the writer found that a capacity of about 1 to 2 microfarads is about the best value to adopt. If the condenser be made much more than 2 microfarads, the sparking at "make"—due to the condenser being then short-circuited by the switch—becomes quite appreciable, especially on 220 volts. Again, decreasing the capacity below about 1 microfarad causes the arcing to approach that occurring without a condenser. Consequently, the writer recommends a capacity of 1 microfarad for a load below 200 watts and 2 microfarads for higher loads. This is applicable to both 100 and 220 volt circuits. A condenser of 0·02 microfarad is quite useless; and the futility of its employment is probably not apparent because very little sparking does occur at a switch controlling only 150 watts.

As regards the suggestion of using a condenser across a switch when working off an A.C. supply, it must be remembered that while the presence of a capacity in circuit prevents the flow of direct current, it allows an alternating

current to circulate; in fact, if the circuit possesses inductance, a condenser facilitates the flow of an alternating current. Consider the lamps when arranged to take 345 watts at 220 volts; their resistance = 140 ohms, and the current = 1·57 amperes. If these lamps were connected in series with the $2\frac{1}{2}$ microfarads across a 220-volt 50-cycle supply, the

$$\text{current} = \frac{220}{\sqrt{(140)^2+\left(\frac{1}{2\pi\times 50\times 2\cdot 5\times 10^{-6}}\right)^2}} = 0\cdot 17 \text{ amp.}$$

The condenser would, of course, prevent arcing at the opening of the switch, but the circuit would not be broken in the sense that it is on a D.C. system.

It may be added that the writer has, without any arcing difficulties, interrupted a current of 1 ampere on a 240-volt D.C. system (the circuit having also an inductance of 0·2 henry) at a frequency of 60 per second with a maximum opening of about 1 m.m. on the circuit-breaker. It was then found that the main effect of varying the capacity from 2 to about 10 microfarads was to alter the wave-shape. But when the capacity was decreased much below 2 microfarads, the arcing intensified rapidly. This, however, shows the wide range through which the value of the condenser can be varied without producing much difference in the arcing at the switch.

No second award is made.

THE METROPOLITAN ELECTRIC SUPPLY CO.

An Amicable Settlement

THE shareholders' committee of the Metropolitan Electric Supply Co., Ltd., consisting of Mr. Roger Gregory (Chairman), Mr. R. Melvill Beachcroft, and Mr. W. S. Poole, have issued their report. We dealt with the circumstances which gave rise to the appointment of this committee in our issues of March 9th, p. 90, and March 30th, p. 118. The annual meeting of the company, which was adjourned until May 2nd, was subsequently further postponed, as the shareholders' committee had not completed its work. The committee now reports having examined into the affairs of the company and the past and future conduct of the business. Upwards of 30 meetings have been held, and all the present directors, except Mr. Moncrieff, have been interviewed, also the three directors who have retired and Mr. Highfield, and the company's other chief officials. Reports have been prepared at the instance of the Board by Sir John Snell, and by Messrs. Jackson, Pixley & Co., chartered accountants. The committee, on its part, instructed Mr. C. P. Sparks (President of the Institution of Electrical Engineers) and Mr. D. H. Allen (of Messrs. Harris, Allen & Co., chartered accountants), to assist it.

The report continues: Having concluded our inquiry, and having carefully considered the evidence, it seemed to us desirable that, if possible, some arrangement with the present board should be come to so as to avoid the necessity of publishing a report dealing with various matters intimately connected with the company's business and affairs, which if made public might seriously interfere with the trading and future prosperity of the company. With this end in view we approached the directors, and are pleased to report that an arrangement has been arrived at, which we believe will be satisfactory to all sections of shareholders, and ensure harmony on the board. Mr. Harrison Cripps has placed his resignation of the chairmanship in the hands of the board. Mr. A. W. Tait, a member of the firm of Messrs. George A. Touche & Co., Mr. George Balfour, of Messrs. Balfour Beatty & Co., Ltd., and Mr. George Verity, chairman of Verity's, Ltd., whom we have suggested as suitable persons (the first-named as chairman), will be added to the board, the number of which is, for the present, at all events, to be limited to seven. The board as reconstituted will be as follows: Mr. A. W. Tait (chairman), Mr. G. Balfour, Mr. G. Blackwell, Mr. W. Harrison Cripps, Right Hon. F. Leverton Harris, M.P., Mr. J. Carr Saunders, and Mr. G. Verity.

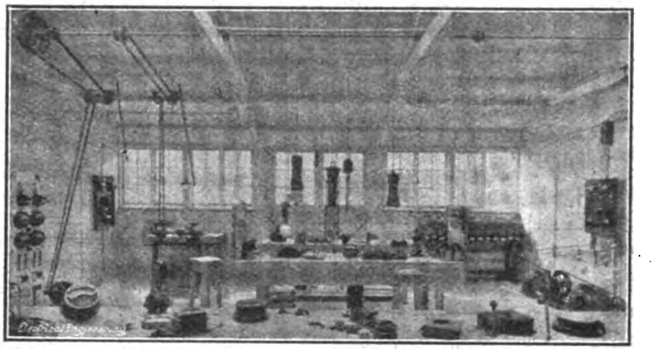
In view of this arrangement, we feel that no useful purpose can be served by referring to the matters of controversy raised at the last meeting of the shareholders. At the same time we feel it right to express regret that personal imputations should have been made on that occasion, which, in our opinion, were not justified. We also wish to record our opinion that the services of Mr. Highfield, as engineer, have been most valuable to the company, and should be retained. We would further add that, in our opinion, the board should direct their special attention to the energetic development of business in the western area. Under all the circumstances, we confidently recommend the shareholders to accept the arrangement indicated above.

An extraordinary general meeting of shareholders is to be held at Salisbury House, E.C., on September 28th, to consider the committee's report and recommendations.

THE QUEEN MARY WORKSHOP FOR DISABLED SOLDIERS

A MOST useful establishment has been provided at the Royal Pavilion, Brighton, by Queen Mary, in the form of a workshop, where partially disabled soldiers can receive training in skilled occupations and fit themselves for a future career. The administration is under Col. Niell Campbell, the commanding officer of the Pavilion Hospital, and the superintendent in charge of the workshop is Mr. A. G. Baker. Mr. R. Mitchell, of the Brighton Polytechnic, has been responsible for organising the classes and equipment, and the establishment is being run on similar lines to the workshop at Roehampton Hospital. The building is divided into four sections devoted respectively to business training, carpentry, electrical engineering, and motor-car repairs. One of the staff of the Brighton Corporation Electricity Works has been lent as instructor in the electrical section, and Mr. J. Christie himself, engineer and manager of the Brighton Corporation Electricity Works, occasionally goes down and lends a hand.

A view of the electrical shop from a photograph kindly sent



VIEW OF ELECTRICAL ENGINEERING WORKSHOP.

us by Mr. Christie is given in the illustration. In this department the men are given a thorough good training in simple wiring for electric light installations, jointing, fixing up of electric bell and telephone installations, repairing, and adjusting arc lamps, and the running of self-contained country house plants. This portion of the premises is lighted entirely by its own self-contained installation, which consists of a small oil engine, dynamo, Tudor battery, and a complete switchboard forming a simple model of a country house plant, upon which men can acquire a full knowledge of the working and maintenance of this sort of equipment, such as will enable them to qualify for employment on estates and in country houses as handy men for doing general repairs and attending to electric light plants. The carpentry and woodwork shops and the motor-car department are equally well equipped, and motor-car driving on the road is also taught.

The Channel Tunnel.—One more strong argument in favour of the much-debated Channel Tunnel scheme has been presented in a letter to the *Times* by Prof. J. A. Fleming, who refers to the increased facility it would afford for direct telephonic communication between Great Britain, France, Switzerland, and Italy. There are at present two English Channel telephone cables, each with twin circuits, which, by the method of usage called phantomising, can be made equivalent to three circuits each. These cables are, of course, subject to the possibility of injury, like all submarine cables, and repairs might be costly and take time. If, however, the Channel tunnel were constructed with proper provision for it, a large number of telephonic and telegraphic cables of a certain type could be laid in it which would afford greatly increased means of intercommunication at a less cost than by equivalent submarine cables. If these were extended by suitable coil-loaded aerial lines, telephonic communication could be established between the principal cities in Great Britain and those in France, and possibly Italy. Having regard to the far closer commercial relations which will exist between the Allies in the post-war period, this improved intercommunication will be of the greatest advantage.

Enemy Firms Wound Up.—The Switchgear Construction Co., Ltd., Park Street, Southwark, S.E., electrical engineers, is to be wound up by order of the Board of Trade under the Trading with the Enemy Amendment Act, 1916. The controller is Mr. J. H. Stephens, 6 Clements Lane, Lombard Street, E.C.—The order made on June 29th requiring the winding-up of Messrs. Turner and Burger electrical accessories merchants, 149 Farringdon Road, London, E.C., is modified, and now prohibits the firm from carrying on business after September 29th.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published September 7th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

11,935/15. **Alternators.** A. H. NEULAND. An alternator provided with a number of pole pieces and a number of teeth on each pole piece, spaced so that, when working, each tooth forms a separate pole, and windings adapted to produce 12 pairs of poles on each pole piece. A single inductor winding surrounds each pole piece, and a toothed rotor without a winding rotates opposite the pole teeth and varies the flux. (Two figures.)

12,361/15. **Ship Propulsion.** B.T.-H. (*G.E. Co., U.S.A.*). A system of electrical ship propulsion employing A.C. induction motors with variable number of effective poles, in which a larger number of poles are used when reversing than when going ahead, to obtain a greater torque. (Three figures.)

1,374/16 (*101,103*). **Motor Control.** IGRANIC ELECTRIC CO. (*Cutler Hammer Mnfg. Co.*). A contactor control system for use on battleships and in other situations liable to severe shocks, embodying special features to prevent accidental working of the contactors. The successively operating contactors are provided with wires actuating and restraining windings. The latter are included in the motor circuit simultaneously after completion of the circuit, and each remains energised until the inclusion in the circuit of the actuating winding closes the contact, short-circuiting the restraining winding. (Two figures.)

6,696/16 (*100,487*). **Discharging Electricity from Cinematograph Films.** C. VAN DEVENTER. A method of getting rid of the static charge apt to be produced on films while moving through a cinematograph camera, which is liable to produce sparks having a photographic effect on the film. An earthed conductor is provided, insulated from the film, and is supported in such relation thereto that the static charge on the film will induce a charge on the conductor. Connected between the conductor and earth is a "diffuser," consisting of a tube of non-conducting material, into which project two conducting points surrounded by metal shot. (Two figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: FRAMPTON and CALLENDER'S CABLE & CONSTRUCTION CO. [Distribution systems] 12,103/15.

Electrometallurgy and Electrochemistry: H. J. KITCHEN and T. BALMFORTH & CO. [Electric furnaces] 8,533/16 (*101,201*).

Ignition: MARKS (*Motor Ignition and Devices Co.*) [Electric supply systems for internal combustion engines] 12,000/15; K. E. L. GUINNESS [Sparking plugs] 6,603/16 (*101,197*).

Switchgear, Fuses and Fittings: E. SCHNEIDER [Voltage regulators] 3,114/16 (*101,175*).

Telephony and Telegraphy: MORSE AND INDO-EUROPEAN TELEGRAPH CO. [Wireless calling apparatus] 10,667/15; MARCONI'S WIRELESS TELEGRAPH CO. and BANGAY [Wireless telegraphy] 16,151/15.

Traction: TURNER [Controllers for electrically-driven vehicles] 15,304/15; BROOKS and HOLT [Electric engine starters] 17,008/15.

Miscellaneous: SOC. ANON. DES ETABLISSEMENTS L. BLERIOT [Regulating means for electrical installations] 23,075/14; G. H. J. HORAN and A. W. GAMAGE, LTD. [Electric buzzers] 2,400/16 (*101,171*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Telegraphy: SIGNAL GES. [Submarine leakage telegraphy] 11,684/16 (*101,223*).

Miscellaneous: CRUCIBLE STEEL CO. OF AMERICA [Motor gyroscopes] 11,752/16 (*101,225*).

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors and Transformers: B.T.-H. CO. (A.E.G.) [D.C. transformers] 11,161/08; M. WALKER [Preventing sparking in rotary converters] 11,956/09.

Incandescent Lamps: P. M. JUSTICE (*Deutsche Gasglühlicht Ges.*) [Filament supporting hooks of carbon] 12,325/06.

Telephony and Telegraphy: J. GARDNER [Subaqueous sound signalling] 12,309/09.

Miscellaneous: W. VON RECHLINGHAUSEN [Vapour electric rectifiers] 11,831/04; G. L. PATTERSON [Primary batteries] 11,154/09.

OVERHEAD TRANSMISSION WIRES

The Board of Trade having received a considerable number of applications for consent to the erection of temporary overhead lines for the transmission of electrical energy, attention is called to the following particulars, which are required by the Department in connection with such applications.

Every application for the consent of the Board of Trade to the placing of electric lines above ground should be accompanied by the following particulars :—

1. Where the undertakers are a company, or a local authority supplying outside their own area, evidence of consent of the local authority for the district.

2. A statement showing commercial or other considerations why underground cables should not be used.

3. A brief description of the proposed system, whether by continuous or by alternating current, the working voltage; the kind of wire, whether copper or aluminium; whether solid or stranded; the total sectional area; tensile strength and elongation; average and maximum length of span; minimum height of wires from the ground; name or description of automatic protective device, if any.

4. A statement whether the supply is to form (1) an extension of an existing system of underground cables, or (2) of an existing traction system, or (3) an independent system.

5. An Ordnance map on a scale of six inches to the mile, showing the proposed route of the overhead lines, and any existing overhead lines. The sheets of these maps must not be fastened together.

6. In the case of high and extra high pressure, plans of construction of poles, &c., on a scale of about one inch to the foot, or a reference to previously deposited plans where these are identical with the proposed work.

FITTINGS FOR HALF-WATT LAMPS

WE have received from Crompton & Co., Ltd. (Chelmsford), a new illustrated list of half-watt lamp fittings suitable for engineering and industrial works and similar purposes. These are on the same lines as certain designs of lantern originally prepared for flame arc lamps, with modifications to suit the peculiar characteristics of the half-watt lamp. A particularly useful form is that shown in the illustration, an important feature of which is the comparatively low cost of glass renewals. It can be fitted with clear, fluted or muranese glass panes, and all the light is directed in a useful downward direction with much less loss than is entailed in the case of opalescent globes. For railway stations and similar work, where full lighting is not always required, a second holder for a small lamp can be added below the large one.

Royal Engineers (T.F.).—Men between the ages of 41 and 47, with a knowledge of any branch of electrical engineering or internal combustion engines, are required for the Corps of Royal Engineers, Territorial Force, and are recommended to apply to the Chief Recruiting Officer, Great Scotland Yard, Whitehall.

LOCAL NOTES

Aberdeen: *Electricity Charges Reduced.*—The Electricity Committee recommend a reduction of 5 per cent. in the charges for electricity as compared with last year.

Bradford: *Extension.*—The proposal of the Corporation to extend the plant at the Valley Road electricity works has been the subject of a conference between representatives of the Electricity Committee and the Members of Parliament for the city. The object is to enlist the support of the local Members of Parliament in an application to the Ministry of Munitions on the subject, but before these recommendations are made the engineer is to prepare a further statement on the matter.

Ilkeston: *Sale of Electricity Undertaking.*—The necessary resolution transferring the Corporation electricity and tramway undertaking to the Notts & Derby Electric Power Co. was passed at the last meeting of the Corporation. The price to be paid is £28,150.

Kirkcaldy: *Power Company and Corporation.*—The Corporation, owing to the lack of plant capacity, is unable to accept an application for a large supply of power by one of the largest and most important firms in the borough. The Fife Electric Power Co., on the other hand, has expressed its willingness to give the supply, but under the Act of Parliament it is unable to do so without the consent of the Corporation. The latter, however, is obviously a little doubtful as to what to do in the matter, possibly owing to the feeling that if the Power Company once gets into the borough it will be difficult to prevent it extending its sphere of operations.

London.—*Notting Hill: Minimum Charge.*—The Notting Hill Electric Lighting Co. has notified its slot-meter consumers that there will in future be a minimum charge of 10s. per quarter.

Rochdale: *A Supply Contract Arbitration.*—A serious dispute arose a short time ago between one of the Electric Supply Department's largest consumers and the Electricity Committee with the result that the matter was placed before Sir John Snell as arbitrator, it being agreed that his decision should be binding on both parties. So far as we have been able to gather the facts, it appears that the Tyre Yarns Co. had a contract with the Electricity Committee for a supply for power purposes in which a coal clause was inserted, but in addition there was a clause stating that the company must be supplied at as low a rate as any other large consumer. Apparently this was not the case, and Sir John Snell has awarded a refund to the company of about £300 for energy supplied to March 31st, 1916, and has also awarded that for the present year the company shall be placed on the same basis as three other large firms in the town.

Sheffield: *Position of Electricity Undertaking.*—At the August meeting of the Corporation, as pointed out on page 312 of our issue for August 17th, it was announced that the accounts of the Electricity Department were not in proper form and they went back to the Electric Supply Committee for further consideration. The Committee now report that they have had the accounts under consideration and can assure the Council that the financial position of the undertaking is absolutely sound and satisfactory and that the accounts are in order.

Swansea: *Supply to Docks.*—Negotiations have been entered into by the Electricity Committee with the Swansea Harbour Trust with a view to taking over the supply of electricity to the Docks.

West Hartlepool: *Extension of Power Station.*—An agreement has been entered into with the Seaton Carew Iron Co. for an extension of the Corporation Power Station at the Iron Co.'s works.

Winchester: *Increased Charges.*—The charges for electric supply for all purposes are to be increased by 15 per cent., and pre-payment meter supplies by one penny per unit.

Obituary.—The death is announced of Sir James Sivewright, K.C.M.G., at a nursing home in Shropshire on Sunday. Sir James was born in 1848, and spent the whole of his professional life in the telegraph service, being first in the Indian Telegraph Service, and consequently acting as general manager of the South African Telegraph System. He retired in 1885, however, and devoted himself mainly to politics in South Africa, but dropped out of public life in 1896, and returned to this country and settled down in Scotland. He was co-author with the late Sir William Preece of a book on Telegraphy which ran into sixteen editions.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Swansea.—The installation of a 3,000-kw. turbo-alternator is recommended.

Miscellaneous

Australia.—The Victorian Railway Commissioners, Spencer Street, Melbourne, require 50,000 yellow flame arc carbons. The specification may be consulted at 73 Basinghall Street, E.C. Tenders by November 1st.

Cardiff.—The Welsh Metropolitan War Hospital, Whitchurch, requires six months' supply of electric lighting accessories. Clerk, September 21st.

London: Westminster.—The Guardians require six months' supply of electric lamps and fittings. Clerk, Guardians Offices, Prince's Row, Buckingham Palace Road, S.W.

Merthyr Tydvil.—The Guardians require a six months' supply of electrical accessories. September 18th. Clerk, 134 High Street.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith and Son, 5, Philpot Lane, inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £131 to £136 (last week £129 to £131).

Dissolution of Partnership.—The partnership between A. C. Heap and W. Pollard Digby, consulting engineers, 48 Westminster Palace Gardens, S.W., has been dissolved.

Messrs. George Ellison.—The Yorkshire branch of this firm has been removed from Sheffield to Standard Buildings, City Square. Telephone, 2577; telegrams, "Switchgear."

Agency.—A Sydney agent wishes to represent United Kingdom manufacturers of small electric motors, dynamos, and Diesel engines. Further particulars at 73 Basinghall Street, E.C., quoting reference No. 283.

Trade with Russia.—The British Vice-Consul at Theodosia reports that there is every opportunity for developing a trade in electrical goods, the whole market in which was previously supplied by Germany and Austria. British firms interested should apply to the Commercial Intelligence Department of the Board of Trade, 73 Basinghall Street, E.C.

APPOINTMENTS AND PERSONAL NOTES

Mr. R. M. Bishop, formerly associated with the Accounts Department of Messrs. Siemens Bros. Dynamo Works, Ltd., 38 & 39 Upper Thames Street, E.C., has been promoted whilst on active service to the rank of sergeant. He had also been awarded the Military Service Medal for conspicuous bravery at Pozières.

The salary of Mr. H. S. Ellis, Borough Electrical Engineer at South Shields, is to be increased from £450 to £500 per annum.

An armature winder is required in the South Shields Tramways Department.

Our Engineering Resources.—In view of the national prominence of the engineering industry, the Lord Mayor is convening a public meeting at the Mansion House, at 3 p.m., on Wednesday, Sept. 20th, to discuss future trade policy, with special reference to the economic utilisation of the engineering works of the nation, which have been so largely expanded in capacity and equipment during the past two years. The organisation of the meeting is being undertaken by the British Electrical and Allied Manufacturers' Association, with the support of the British Engineers' Association, the British Empire Producers' Organisation, and the Engineering and Electrical Sections of the London Chamber of Commerce. Applications for tickets of admission should be sent to Mr. T. C. Elder, Organising Secretary for the meeting, B.E.A.M.A. Offices, 36 Kingsway, London, W.C., or to the Secretaries of any of the above organisations.

TRADES DIRECTORY OF
ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
Fletcher (H. J.) & Co., Bridge Works, New North Rd., London, N.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sloog, H., 51, Anson Rd., London, N.W.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

HEATING AND COOKING APPARATUS.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
The Bastian Electric Co., Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Phœnix House, King William St., E.C.

LADDERS.
Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
"Lamlok," 18, Ranelagh Gdns., Hammersmith, W.
London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.

LAMPS (Incandescent)—*contd.*
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

MECHANICAL STOKERS.
Underfeed Stoker Co., Ltd., Coventry House, South Place, E.C.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

MOTORS AND DYNAMOS.
British Thomson-Houston Co.. Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Langdon-Davies Motor Co., 110, Cannon St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PACKING.
Dermatine Co., Ltd., Neate St., London, S.E.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons. Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

RUBBER GLOVES.
Ingram (J. G.) & Son, Hackney Wick, N.E.
Moseley (D.) & Sons, Ltd., Ardwick, Manchester.

STEAM ENGINES AND TURBINES.
Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk St., W.C.
Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
United States Metallic Packing Co., Ltd., Bradford.

SWITCHGEAR.
British Thomson-Houston Co., Ltd., Rugby.
Dorman & Smith, Ltd., Ordsal Electrical Works, Salford.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Electric Control, Ltd., 177, Reid St., Bridgeton, Glasgow.
Ellison (George), Warstone Lane, Birmingham.
Ferguson, Pailin & Co., Ltd., Hr. Openshaw, Manchester.
Ferranti Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Igranic Electric Co., Ltd., 147, Queen Victoria St., E.C.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.

TECHNICAL BOOKS.
Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
Constable (Archibald) & Co., Ltd., 10, Orange St., Haymarket, W.
Crosby Lockwood & Son, 7, Stationers' Hall Court, E.C.
Macmillan & Co., Ltd., St. Martin's Street, W.C.

TELEPHONES.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Graham (Alfred) & Co., St. Andrew's Works, Crofton Park, S.E.
Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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SUMMARY

A lecture given in America by Mr. R. B. Chillas describes an investigation into the best sizes of carbons for different sizes of searchlights, and contains much practical information as to their burning, with some notes on recent developments in the use of flame carbons for searchlight purpose, for which such special apparatus as the Beck and Spery lamps have been designed (p. 358).

The British Association Committee for Radio-telegraphic investigation reports that a small amount of work was carried out last year (p. 359).

Good progress is being made with the organisation of the Federation of British Industries (p. 359).

Our Questions and Answers page this week outlines methods of design of D.C. interpole motors when standard frames, punchings, etc., are available (p. 360).

Among the subjects of specifications published at the Patent Office last Thursday were telegraph call signals, traction controllers, and defence against torpedo attack. Patents relating to electric traction and printing telegraphs expire this week after a full life of 14 years (p. 361).

The manufacture of hard paste porcelain, hitherto considered a Continental product, is now being carried on from materials obtainable in England (p. 361).

We give an illustrated description of a new-pattern Sandycroft liquid motor-starter. This is of the circular-drum type, the lower half being filled with electrolyte, and the upper half containing the dipping blades (p. 362).

A new form of wet cell, of Ediswan make, is described in an illustrated article. It is sold dry for storage purposes, and requires only the addition of water to make it ready for use (p. 362).

There was a net profit of £7,912 at Bristol last year, £2,395 at Warrington, and £1,856 at Wolverhampton. Small losses were incurred at Maidstone, South Shields, and Bath (p. 363).

Interim dividends of 5 per cent. less tax for the June half year are announced by the British Insulated & Helsby Cables and the Lancashire Dynamo & Motor Co. (p. 364).

1st LONDON ENGINEER VOLUNTEERS

Headquarters: Chester House, Eccleston Place.
Orders for the Week, by Lt.-Col. C. B. Clay, V.D., Commanding.

Friday, Sept. 22nd.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits Drill, 6.25—8.25.

Saturday, Sept. 23rd.—Instruction Class, 2.30. Coy.-Cdr. Fleming.

Sunday, Sept. 24th.—Entrenching at Otford. Parade Victoria (S.E. & C. Ry.) Booking Office, 8.45 a.m. Uniform, haversacks, water bottles. Midday ration to be carried. Railway vouchers will be provided.

Corps Meeting.—A general meeting will be held on Saturday, Sept. 30th, at 5.30.

Officer for Next Week.—Platoon Commander C. H. C. Bond.

Next for Duty.—Platoon Commander Hughes Hallett.

Monday, Sept. 25th.—Technical for Platoon No. 9 at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25—8.25.

Tuesday, Sept. 26th.—Range Practice.

Wednesday, Sept. 27th.—Lecture: W. Eyles, Esq. (late R.E.), 6.15., "Demolitions." Platoon Drill, Platoon No. 2. Range Practice.

Thursday, Sept. 28th.—Instruction Class, 5.45. Platoon Drill, Platoon No. 6. Range Practice.

Friday, Sept. 29th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25.

Saturday, Sept. 30th.—General Parade, 2.45; uniform. General Meeting of Corps, 5.30. The Commandant hopes to see a large attendance.

Sunday, Oct. 1st.—Entrenching at Otford. Parade, Victoria (S.E. & C. Ry.) Booking Office, 8.45 a.m. Uniform, haversacks, water-bottles. Midday ration to be carried. Railway vouchers will be provided.

Musketry.—For all Companies, see Notice and Tables A and B at Headquarters.

Note.—Unless otherwise indicated, all drills, &c., will take place at Headquarters.

Northampton Polytechnic Institute.—A copy of the announcements for the approaching session at the Northampton Polytechnic Institute is issued by the Principal, R. Mullineux Walmsley, D.Sc. The arrangements include day and evening courses in engineering (civil, mechanical, and electrical), in technical optics, and in horology. The engineering courses include sub-sections in automobile work, aeronautics, and radio-telegraphy. In addition there are evening courses in electro-chemistry, metallurgy, and domestic economy. The classes for the day courses commence on Monday, October 2nd, and those of the evening courses on Monday, September 25th. Enrolments for the latter have already commenced. As a "war emergency arrangement," the starting of any particular class will depend on the number of applications received for enrolment early in the session. With this limitation the governing body is prepared to start any or all of the classes scheduled.

Industrial Chemistry at Bradford Technical College.—We have received a pamphlet dealing with the provision made at Bradford Technical College for instruction in industrial chemistry and dyeing. The scheme affords a broad and sound training for students preparing to enter the various chemical industries, and it is now generally recognised that a greatly increased demand will arise for well-trained chemists to cope with the great extension of British chemical industry which is now taking place, and which will be still more marked after the war. The pamphlet contains a list of some of the positions, at salaries of £160 to £500, obtained by students who have left the College within the last five years.

Dangers of Crane Electro-Magnets.—That it is necessary, when using electro-magnetic lifting devices on cranes, to take precautions that the current supply to the magnet cannot possibly fail, was demonstrated at a munition works in the Sheffield district last week. Here a crane was being used for stacking iron bars which were being lifted by an electro-magnet. Apparently one of the crane trolleys jumped off its wire and hit a neighbouring wire, causing a short circuit which opened a main circuit-breaker and cut off all the current, including that supplied to the magnet. The result was that four heavy iron bars dropped and fell on to a man, with fatal results.

Association of Supervising Electricians.—The first meeting of the session will be held at St. Bride Institute, Bride Lane, Ludgate Circus, E.C., on Tuesday, September 26th, when Mr. A. P. Trotter will deliver his Presidential Address.

AMERICAN EXPERIENCE WITH SEARCHLIGHT CARBONS

AN interesting lecture on searchlight carbons by Mr. R. B. Chillas, of the experimental laboratory of the American National Carbon Co., delivered before artillery students in America, is reprinted in the *Journal of the United States Artillery*.

A brief outline is first given of the general process used in the manufacture of carbons from the raw materials, which consist of lamp black, coke, and tars and pitches as binding material, suitably pressed and baked with or without the addition of a core containing chemicals for steadying the arc or colouring the flame. A discussion is then entered into at some length of the conditions governing the choice of the proper carbons for a given current.

The function of the positive carbon is to produce a light of the maximum efficiency, steadiness and concentration, while the negative carbon, which is more important from the electrical standpoint, must maintain a steady arc, cause the least possible sacrifice in the efficiency, and permit the required degree of control in the lineal burning ratio of positive to negative. A searchlight should excel in the following particulars: Small positive crater, with high current densities, and thus high crater temperature and high intrinsic brilliancy, small negative carbon, long arc length and uniformity of carbon mixture.

In the course of a series of experimental tests with standard sizes of carbons, it was found that when the arc is on the negative shell, instead of on the core, the arc stream issues from a very small bright spot as a high velocity blast in a direction normal to the carbon surface. If this surface is directly facing the positive, the stream is straight and usually steady; if not, the arc must bend outward towards the positive and unsteadiness, hissing and rapid wanderings of the arc occur, often resulting in a break. For a 200-ampere 70-volt arc the diameter of the negative spot is estimated at 0.07 to 0.1 in., corresponding to a current density of 25,000 to 50,000 amperes per square inch. The diameter and the current density of the positive bright spot or crater are 0.8 in. and 400 amp. per sq. in. With large negative the prevailing shape of the tip of the negative carbon is bent and rounded, or even slightly cupped with cored negatives, and unsteadiness is bound to occur. With properly chosen carbons, the negative bright spot scarcely wanders from the top of the carbon; in fact, a small graphitised "wart" about 0.1 in. diameter forms on the end of the carbon and the arc persistently stays on this tip. On the standard American G.E. 60 in. lamp with 2 in. diam. positive and 175 to 200 amperes, the arc on the positive wanders sufficiently to keep a fairly well-formed crater, though the actual hot spot does not nearly cover the end of the carbon. This necessarily leads to unsteadiness and poor efficiency in the beam, or the bright spot cannot be held accurately at the focus, and the average crater temperature is comparatively low. Progressive tests of different sizes of carbons were made, and it was found that a marked improvement could be made by decreasing the size of the positive, but the smallest plain carbon that can be used satisfactorily without special devices to prevent "spindling" is that of 1⅝in. diam., in which the arc crater very nearly covers the end of the positive. The texture of the carbon also has some influence on the formation of the crater. [By "spindling" is meant burning away of the outer part of the carbon for a little distance away from the point, causing the available area of the point to become insufficient for the crater area.] Some further improvement was also made by reducing the size of the core hole in the positive.

The determination of the proper size of the negative carbons was then undertaken, and it was seen that although it was possible to choose a plain negative carbon which would have the capacity to carry continuously such a current as would give a positive crater covering the tip, a carbon of this size would tend to burn noisily and be unsteady. Smaller carbons tend to spindle excessively. Increased current-carrying capacity was therefore required without increase of diameter, and this was best obtained by copper coating. It was found, however, that, beyond a certain point, further increase in the amount of copper gives a relatively small decrease in resistance. A small, heavily-coated carbon, worked at a high-current density, melts the copper at the tip, consumes very rapidly, and gives no better steadiness than a slightly larger carbon with less copper. The best negative from the standpoint of efficiency and steadiness is such a one as will require somewhat less than 0.003in. copper to give satisfactory continuous working.

Changes in the amount of copper and slight changes in diameter from that which gives the best steadiness present the opportunity for a certain degree of control over the burning ratio, so that the most suitable lamp-feeding ratio may be adopted. This ratio may be made one to one with little or no sacrifice in efficiency, which simplifies lamp construction. One large American manufacturer, however, has used a ratio of 1.65 to 1 for a number of years. The new sizes of carbons adopted on the basis of the above investigations give rather less available burning hours per diem than the previous standard sizes. The lives of the new carbons vary from 2.75 to 8.75 hours, but the advantages in working greatly outweigh the somewhat shorter life.

With regard to the effect of the current on the burning ratio, it has been found that the ratio of volumes consumed increases as the size of the carbons and current increases— that is, a large volume of positive carbon is consumed for a given volume of negative carbon in the larger than in the smaller sizes. Since the ratio of volumes consumed is equal to the product of the ratio of the area of positive to negative, and since, for a given set of conditions, this is nearly constant; for a given volume ratio, either the area ratio or the burning ratio must be changed as the size increases. It has also been found that the cross section of a copper-coated negative which will burn with a well-pointed tip and lies in the region of the best control of the copper coat is proportional to the current plus a constant, with positives selected to have a crater covering the tip, it is found that the current density increases as the size increases, since the radiating surface per unit volume decreases, and the wattage per unit volume when the carbon has burned to shape rapidly increases with increase in diameter, the working temperature of the tip tends to rise and, therefore, the rate of consumption of the positive increases at a rate more than proportional to the current. The one to one ratio most nearly fulfils the requirements of good burning up to about 125 amperes, but for sizes as large as 200 amperes, 60-70 arc volts, the best burning ratio is 1.35 to 1, with a 35mm. positive and a 16mm. negative.

The preceding considerations are based on continuous steady working, but owing to the altered conditions at starting and the slower heating up of the negative carbon the rate of consumption of the negative is slower at the start, so that the burning ratio under intermittent working is increased. It follows that a pair of carbons which burned continually shows the correct burning ratio does not necessarily maintain the crater in focus during the entire run. With the new sizes arrived at, however, steady conditions are reached in a slower time than with the older standards.

Recent developments are pointing to the increased use of flame carbons for searchlight work, and certain lamps are being developed for the purpose. It has been found that the positive arc crater on an impregnated flame carbon is of decidedly smaller area than the crater on a pure carbon. A much more concentrated beam is available, and by a proper choice of the flame material a further increase in the quantity of light produced is secured. These carbons, consisting of a pure carbon shell with an impregnated core, are worked at a current density so high that special cooling devices are required, and only a very short length of the carbon actually carries the current. A 150-ampere lamp now under test has a 16mm. flame cored positive and an 11mm. cored negative. The actual positive crater is almost 14mm. in diameter. The negative carbon is inclined at an angle of about 90 deg. below the arc and is in such a position that the central tongue in the negative arc flame strikes almost on the upper edge of the positive crater. The positive crater is continuously rotated and fed forward and turns a symmetrical crater about 10mm. deep filled with the highly incandescent gas of the flame arc. This gives an extremely concentrated light source of high candle-power, which is practically ideal for searchlight requirements.

The Beck and Sperry lamps which have been developed for this class of work show the following important differences: The Beck lamp makes use of a spray of alcohol or other hydrocarbon against the hot tips of the carbons. The alcohol ignites, but the temperature of its flame is said to be sufficiently below the working temperature of the tips to act materially as a cooling agent. In addition, the products of combustion act as a protective sheath to prevent undue oxidation. In the Sperry lamp, on the other hand, the cooling is accomplished and spindling is prevented by means of an air-cooled copper radiator, which surrounds the positive nearly up to the tip. Immediately in front of this radiator is a short fused silica tube, out of which about half to three-quarters of an inch of carbon is allowed to project.

Air is supplied by a small motor driven blower to this radiator and also to the negative holder.

The following table of the standard sizes of carbons established by the National Carbon Co. on the foregoing considerations is given in an appendix :—

Size of Searchlight.	Current Amperes.	Arc Voltage.	Carbon Sizes. Positive.	Negative.	Burning Ratio.
inch.			mm.	mm.	
9	10	46-49	13 × 120	8 × 110	1 : 1
12	20	48-51	16 × 140	9 × 130	,,
18	35	50-54	16 × 180	9 × 160	,,
24	50	50-54	19 × 250	10 × 230	,,
30	80	55-59	25 × 250	11·5 × 230	,,
36	120	58-62	28·5 × 250	13 × 230	,,
60	200	67-75	35 × 250	16 × 300	1·35 : 1

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

The report of the British Association Committee for radio-telegraphic investigation, presented at the Newcastle meeting, states that the observational work done for the committee during the past year has been carried out at about 25 stations distributed in Australia, the United States of America, Canada, New Zealand, Ceylon, Trinidad, Dutch East Indies, Fiji, and the Gold Coast. Of the four kinds of forms issued by the committee for the collection of statistics the first relating to the number and strength of the strays at 11 a.m. and 11 p.m. Greenwich Mean Time, has been in most regular use, and the stock is almost exhausted. No further edition of this form will be issued during the war, and thus the collection of statistics will come gradually to an end. The difficulty of obtaining clerical assistance for the work of reducing the forms has greatly impeded progress; but a certain amount of work has been accomplished, and has yielded results of interest. So soon as the several sections of the work are rounded off the results will be published. The reduction of Form I. is proceeding by the collation of records and reports of excessive atmospheric disturbance since August, 1914, in North America and Australia, and by their examination in conjunction with meteorological data from the corresponding daily weather charts. The reduction of Form II. is proceeding by the correlation of instances of exceptionally good or bad transmission with meteorological data, and by analysis of statistics from Cocos, Fiji, Lagos, Malta, and Sierra Leone. Several important exceptional phenomena have been reported, which will, after discussion, be published. These include reports of: Aurora, strays and signals in Alaska and Hudson Bay; severe atmospheric disturbances in Malta; simultaneous strays on both sides of the Atlantic; and the effect of a tropical storm in the Gulf of Mexico on September 30, 1915.

FEDERATION OF BRITISH INDUSTRIES

CONSIDERABLE progress has now been made with the arrangements for putting the Federation of British Industries into practical working order. This body may be regarded as the outcome of the proposal made in the report of the Manchester Engineers' Club (ELECTRICAL ENGINEERING, November 25th, 1915) that a comprehensive organisation, which would be able to speak with a powerful collective voice in Parliament, would assist the Government in questions connected with industry and commerce, and would be entitled to representation on the governing bodies of universities and technical colleges, should be formed without delay to take advantage of the present opportunities in all the engineering industries, and to meet the conditions which will follow the termination of the war. The object of the Federation, the credit for the foundation of which is due to Mr. F. Dudley Docker, Chairman of the Metropolitan Carriage, Wagon & Finance Co., is to take under its care all important matters of principle connected with the various engineering industries, leaving it to the existing trade associations to carry on the detail work appertaining specially to them, as is now the case. At a meeting in London on July 20th, the nucleus of the Federation was formed, and a provisional Executive Council was appointed. This body, which has been sitting frequently since, has now drawn up rules which have been deposited with the Registrar of Trade Unions, it having been decided to register the Federation in this way.

Air is supplied by a small motor driven blower to this
tion is well in hand, and a general meeting will shortly be held to confirm the action taken by the original Executive Committee, and to appoint a new body fully representing the various industries.

That such an organisation is now felt to be necessary is evident from the large number of important firms which have already joined, and new applications are coming in daily. The scope of the organisation proposed by the Manchester Engineers' Club was that there should be Standing Committees in regard to the following departments, namely :—General Purposes; Intelligence; Production; Inventions and Patents; Publicity; Finance; Education and Research; and Parliamentary; and it may be taken that the Federation will be organised somewhat on these lines.

Arrangements have also been made by which existing individual trade associations, such, for instance, as the B.E.A.M.A., are joining the Federation as members, and these dispose of the difficulties which at one time were thought likely to arise as between the more comprehensive body and the existing associations.

QUESTIONS AND ANSWERS BY PRACTICAL MEN

IN view of conditions due to the absence on military duty of a number of members of our staff, as well as the pre-occupation of many of our readers on war service, questions will for the future only be offered for competitive replies fortnightly.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final

QUESTION No. 1,510.

A modern 60-b.h.p., 3-phase, 50-cycle induction motor, 420 volts, 480 r.p.m., with wound rotor, drives with belt a Bailey's single-stage double-acting air compressor, whose capacity is 400 cubic ft. per minute at 35 lb per square inch, running at 160 r.p.m. Cylinder, 375 m/m.; dia. stroke, 350 m/m.; pulley, 60″ dia.; motor pulley, 20″ dia. There is an automatic valve which stops the motor at 40 lb., and when this pressure drops to 35 lb. it should start again. The valve is working well, but the motor refuses to start, although it takes 120 amps. from the line. If this pressure is dropped to 25 lb. it will start. Why does the motor refuse to start?—AIR.

(*Replies must be received not later than first post, Thursday, Sept. 28th.*)

ANSWERS TO No. 1,510.

Give a *brief* outline of the method followed by a manufacturer in designing industrial D.C. interpole motors, using standard frames, punchings, &c., whose magnetic and electrical characteristics are known from tests.—R. R.

The first award (10s.) is made to "Arc" for the following reply :—

The specification for a D.C. motor always states the horse-power, voltage, speed, field winding (*i.e.*, shunt, series, or compound), and whether the machine is to be open, protected, or totally enclosed, &c. The permissible temperature rise after a full-load run of a certain duration, the overload capacity with-

out injurious sparking or excessive temperature rise, and the efficiency at various loads are also frequently specified; if not, they have to conform to the standard specification issued by the manufacturing firm.

With the above data the procedure is as follows :—(a) From one of the ratios $\frac{\text{b.h.p.}}{\text{r.p.m.}}$ or $\frac{\text{input watts,}}{\text{r.p.m.}}$ fix upon the smallest permissible frame; either the one or the other of these ratios will have been determined from tests for each type of machine. (b) Decide upon the type of armature winding and the number of commutator segments from considerations of the current and voltage respectively. It is usual to have two or more standard commutators of the same diameter but with different number of segments. The maximum allowable voltage per segment, however, is not a definite quantity, and each designer decides it according to his own experience. If there is more than one standard length of commutator for the machine in question, the required length and the number of brushes per spindle are determined from the armature current, number of brush-spindles, width of brushes, and permissible current density. It is only in special cases that one checks the probable temperature rise of the commutator from the friction and resistance losses and the heating constant. (c) Assuming the normal value of the magnetic flux, and deducting a small percentage from the terminal voltage to allow for the resistance drop in the armature circuit, calculate the approximate number of armature conductors. This figure must be corrected slightly to suit the number of commutator segments and the type of winding. Also, find the number of conductors per slot.

(d) Assuming a certain current-density (based upon experience), find the approximate cross-section of each armature conductor. Refer to a table of S.W.G. to obtain the nearest size available; and from a knowledge of the diameter (including insulation), check whether the required number of wires can be got into the slot after allowing for standard slot insulation and clearance.

(e) From the mean length per turn, calculate the resistance of the armature winding; and correct the value of the magnetic flux, making a small allowance for the resistances of the series (if any) and interpolar windings.

(f) Estimate the iron loss in the armature core, and add to the copper loss. The heating constant being already known, the probable temperature rise can be calculated. If this is too high, the section of conductor or the magnetic flux (or both) must be altered so as to bring it within the permissible limit. If it is too low, both the section of copper and the flux can be decreased to some extent, and thus give a cheaper machine.

(g) From the magnetising curve, determine the number of ampere-turns per pole required on no-load to produce the necessary flux, and add a certain percentage of the armature ampere-turns per pole to allow for armature reaction.

(h) Calculate the field winding. For a series machine a certain current density is assumed in order to get at the section of wire, and the nearest standard size is taken. The number of turns per coil is given by $\frac{\text{ampere-turns per pole;}}{\text{current}}$ hence the size and resistance of coils can be determined. From the heating constant the temperature rise of the field winding can be estimated. If this is not approximately near to the permissible value, the size of wire should be altered.

With a shunt field the mean length per turn is assumed; then the section of the wire given by

$$\frac{\text{specific resistance} \times \text{amp-turns per pole} \times \text{mean length} \times \text{no. of coils in series.}}{\text{terminal voltage}}$$

From the size of bobbin and the diameter of the wire (with covering) the number of turns and the resistance can be calculated. Check the heating as in the case of the series winding. The series and shunt windings of a compound motor are also calculated as just described.

(i) Find the number of ampere-turns per pole required on the interpoles. For standard machines the simplest method of doing this is to add a certain percentage (based upon experience) to the armature ampere-turns per pole. This method generally gives quite as satisfactory results as those based on more elaborate calculations. The section of wire, number of turns, resistance, and temperature rise are then proceeded with as for a series winding; and the clearance between the interpolar and main field windings is checked to ensure the ventilation being ample.

(j) Estimate the friction and windage losses; add them to the copper and iron losses, and thence determine the efficiency. This may have to be done for different loads. Check these values with those given in the specification.

In this answer no figures are quoted, because they are different for different makers, and are generally almost useless unless the method by which they are determined is given.

The second award (5s.) is given to "Flash" for the following :—

In getting out designs for D.C. interpole motors where magnetic and electrical characteristics of the standard frame sizes are known, the procedure followed by various manufacturers is more or less similar and is generally on the following lines :—

Armature.—From tests the magnetic loading (*i.e.*, flux in C.G.S. lines or density in air-gap) and electrical loading (*i.e.*, ampere conductors per centimetre of armature circumference and current density per millimetre^2 of conductor), corresponding to each frame size, is known for the various time ratings and speeds.

Assuming that each size of armature has one standard number and size of slot—which is reasonable for small machines, although in the case of larger machines the number of slots would have to be chosen to suit the voltage and winding—then the H.P. outputs possible are easily ascertained. Allowing for trough insulation, tape round coils and banding grooves, &c., take suitable sizes of A.C.C. round copper wire, and find how many conductors can be got into the slot. The number of conductors finally chosen to be such as to give a suitable winding and adequate number of commutator bars. Windings of greater section than two of No. 13 S.W.G. in parallel should be of copper strip rectangular section, as sizes of round wire greater than this are awkward to wind, and have a bad space factor. The copper strip should be chosen of such dimensions so that it can be arranged two conductors in depth per slot and a total of 12, 10, 8, 6, 4 conductors per slot are required.

The above gives the number of turns on the armature for certain sizes of conductors, and, knowing the current density, we can find the current the armature is capable of carrying, the resistance, and the voltage drop; also, knowing the flux and the voltage for which the machines are being designed, we can find the minimum speed for that armature and winding by the rule :—

$$\text{R.P.M.} = \frac{\text{Armature internal voltage} \times 60 \times 10^8 \times \text{No. of circuits.}}{\text{Flux per pole} \times \begin{array}{c}\text{Total conductors on}\\ \text{face of armature}\end{array} \times \text{No. of poles.}}$$

On four-pole windings the alternative of four-circuit windings, in preference to two-circuit would have to be considered for low voltages. For standardisation purposes windings are usually got out for voltages of 110, 220, 440, and 500. After the winding to suit the required speed has been found, the values of ampere wires and current density should be checked to see that they are permissible for that speed. The value of ampere wires per centimetre × current density is a measure of the C^2R losses of the machine, and for machines of one-frame size, rating, and of normal speed is about constant.

Commutator and Brush Gear.—The number of commutator bars will be chosen with regard to commutation, and the length will be standardised for 2, 4, 6, &c., brushes per spindle, according to the size of the machine and current density permissible in the brushes.

Interpoles.—The interpole ampere turns for any one-frame size will bear a certain relation to the armature ampere turns, usually the ratio $\frac{\text{interpole amp. turns per pole}}{\text{armature amp. turns per pole}} = 1{\cdot}5$ approx. The current density of interpole known, the section of wire and number of turns can easily be decided upon.

Main Field.—From the tested values the saturation curve of machine—*i.e.*, flux per pole plotted against ampere turns per pole—is drawn out for standard and larger air-gaps, so that when the flux is known the corresponding ampere turns can be easily ascertained without going through the complete calculation of the magnetic circuit. For a normal interpole machine the ratio of field to armature ampere turns should be 1, but in the case of variable-speed motors this ratio may be reduced as low as 0·3 at the top speed, without reaching instability or bad commutation.

Shunt Coils.—When the shunt ampere turns are known, the section of conductor can be found by the dule :—

$$\begin{array}{c}\text{Section of conductor}\\ \text{in millimetre}^2\end{array} = \frac{\text{No. of poles} \times 1{\cdot}25 \times \text{A.T. per pole} \times \text{Length mean turn-cms.}}{\text{Excitation volts} \times 5{,}700.}$$

If with standard air-gap this gives a section of conductor between two standard stock sizes, the larger size should be chosen and the air-gap increased to take up the difference in ampere turns. From the known value of current density the amps. and turns per pole can be found.

A number of designs, graduating between the most common voltages and speeds, could be calculated on the above lines and tabulated in a convenient form for each frame size once and for all.

Thermit, Ltd.—With reference to the announcement on page 344 of our issue of September 7th, that Thermit, Ltd., has been wound up and that the whole of the shares have been acquired by the Birmingham Metal and Munitions Co., Ltd., we are informed that the whole of the shares have been sold to the latter company, and that there was, therefore, no necessity to wind the company up. The company is still being carried on by the Birmingham Co., under the name of Thermit, Ltd.

London Electrical Engineers (T.F.).—The following Sec.-Lieuts. are to be temporary Capts. as from July 1st: S. Mathews, R. C. Milliken, J. Gibson, J. R. Birch, J. G. S. Gabriel, H. F. G. Roose, R. Englebach, H. G. G. Clarke, C. H. S. Evans.—Pte. H. F. Cousins, Artists' Rifles, O.T.C., is to be Sec.-Lieut. (on probation), dated August 13th.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published September 14th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

10,667/15. **Call Signal.** A. H. MORSE and INDO-EUROPEAN TELEGRAPH CO. A calling signal for wireless or other telegraphy, in which a stream of liquid issuing from a jet is deflected under the control of the received signal, and causes the liquid to accumulate in a receptacle for a predetermined period corresponding to the length of the calling signal, and to close the calling or alarm circuit when the level of the liquid reaches a certain point. (One figure.)

11,839/15. **Defence from Torpedoes.** K. O. LEON. A method of defending ships against torpedo attack by launching defending torpedoes, on approach of attacking torpedo, exploded by time-fuses or otherwise. It is proposed to control the launching of these automatically by microphones detecting the approach of the torpedo, as in submarine signalling. (Two figures.)

15,304/15. **Traction Controller.** P. S. TURNER. A form of "dead man's handle" controller, which can be set when required so that it can be let go of by the driver without applying the brakes for observation of signals, etc. A switch is provided which cuts off the main motor current, as well as the control circuit current, without interfering with the lighting and other auxiliary circuits. The electrical gear operating the brake valve is thus put out of action. (Two figures.)

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: BULLERS, LTD. and G. V. TWISS [Supporting and insulating electric lines] 1,309/16 (*101,233*); G. H. SCHOLES [Cable joint] 1,635/15 (*100,237*).

Heating and Cooking: NOBBS and NOBBS [Heating and cooking apparatus] 12,318/15.

Ignition: KETTERING and CHRYST [Electrical systems of use with internal combustion engines] 7,757/15.

Switchgear, Fuses, and Fittings: ROSS [Step-by-step rheostat switches] 12,309/15; QUINCEY [Fittings] 13,062/15; J. SALT [Lamp holders] 4,575/16 (*101,250*).

Telephony and Telegraphy: FORRESTER (*Piersen Telegraph Transmitter Co.*) [Telegraph transmitters] 8,012/15; BRITISH INSULATED AND HELSBY CABLES, LTD. and HARRISON [Telegraph systems] 12,561/15; RELAY AUTOMATIC TELEPHONE CO. [Automatic telephone systems] 12,673/15; SMITH [Field telephone lines] 17,034/15; W. J. MELLERSH-JACKSON (*Western Union Telegraph Co.*) [Telegraph transmitters] 9,193/16 (*101,278*); V. G. WERNER and K. H. WARFVINGE, 11,397/16 (*101,281*).

Traction: TURNER [Distribution systems for electric traction] 15,303/15; ALBION MOTOR CAR CO. and T. B. MURRAY [Car lighting] 3,559/16 (*101,243*).

Miscellaneous: BRITISH THOMSON-HOUSTON CO. (*G.E. Co., U.S.A.*) [Electrical ship propulsion] 12,444/15; WALL [Generation of high-frequency currents] 12,536/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Telephony: O. THOKLE [Transmitter mouthpiece] 12,070/16 (*101,296*).

Traction: W. O. WADE and C. C. CHAPPELLE [Devices for registering the coasting and stopping period of cars] 10,622/16 (*101,290*).

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

20,755/02. **Traction.** O. IMRAY (*Sprague Electric Co.*). A multiple unit train control system with automatic acceleration controlled by time lag attachments to the contactors.

21,090/02. **Telegraphy.** J. GELL. A perforating machine for use in conjunction with automatic transmitters for type-printing telegraphs.

HARD PASTE PORCELAIN

THE extent to which Germany in particular and Continental countries in general had a grip on the electrical industry in this country before the war is too well known to need emphasis. A repetition of the fact, however, serves to introduce an example of the manner in which a British firm set itself successfully to work to ensure that one market at any rate shall not be so free to the foreigner in the future. Porcelain plays an important part in the electrical industry for innumerable purposes; but although the English-made article, with its ivory appearance, held its own, yet there was a large demand for German hard-paste porcelain, with its rather glaring white colour. Upon its physical and electrical properties as compared with the English product it would be difficult to be dogmatic, yet there was undeniably a call for it. The reason why British firms had not attempted to produce a hard paste porcelain we will not attempt to inquire into, beyond saying that the Germans, once they got a market, knew well enough how to keep it.

It is not surprising, however, that the war changed our attitude towards this as to many other matters. The pottery trade lent its voice to the general cry for State aid, and the Committee of the Privy Council for Scientific and Industrial Research made a grant of £1,000 to the governing body of the Pottery and Mining Schools, Stoke-on-Trent, for the establishment of research work into the manufacture of hard porcelain, success in which it is hoped will better enable British manufacturers to compete with German felspar or hard paste china. This was an important step in the interests of the pottery trade as a whole, coupled as it was with the promise of an increase of the grant to £10,000, and the value of the work now in hand cannot be over-estimated.

At the same time, we are pleased to see that the qualities of individualism upon which the commercial greatness of the British Empire has been so largely built have not been swept away in the universal demand for State aid. Many economists regard this as a form of State Socialism which might be dangerous as likely to stifle commercial progress if manufacturers went to sleep in the belief that the State was working for them. Messrs. Taylor, Tunnicliff and Co., of Eastwood Works, Hanley, Staffordshire, however, who supply so much porcelain ware for the electrical trade, have not fallen under any such delusions. Quite independently of the work being carried on by the aid of the Government grant at the Pottery Schools, they have at their own laboratories, and at considerable expense, carried on research work in conjunction with Mr. C. Herbert Thompson, F.C.S., of Amblecote, which has resulted in the actual production on a commercial scale of a wide range of hard paste porcelain parts for the electrical industry from materials obtainable in this country. The plant at present in use is an experimental one, but larger plant is in course of erection, and in a few months' time the firm will be able to supply these hard paste porcelain goods, hitherto always considered a Continental product, as an ordinary line of manufacture.

Birmingham Chamber of Commerce.—So great has been the expansion in the membership and consequently business of the Birmingham Chamber of Commerce, that for many years there has been felt a growing need for the establishment of a central house of commerce. Consequently, the Chamber has entered into a contract for acquiring the Colonnade Buildings in the centre of New Street, an imposing island block, the interior of which meets every possible requirement. The ultimate cost of carrying out the scheme will be about £50,000, and an appeal is made to the commercial community of Birmingham and the district to subscribe funds for the purpose in view. Up to the present, as a result of private efforts, nearly £22,000 has been raised.

NEW PATTERNS OF THE SANDYCROFT STARTER

MANY of our readers are familiar with the Sandycroft patent enclosed liquid starter, and there is no doubt that its good points went a long way towards removing the prejudice that existed at one time against liquid starters in general.

The apparatus consists essentially of a circular drum, in the lower half of which the electrolyte is contained, while in the upper half are mounted special crescent-shaped dippers connected by insulated bolts with sliding contacts on the exterior

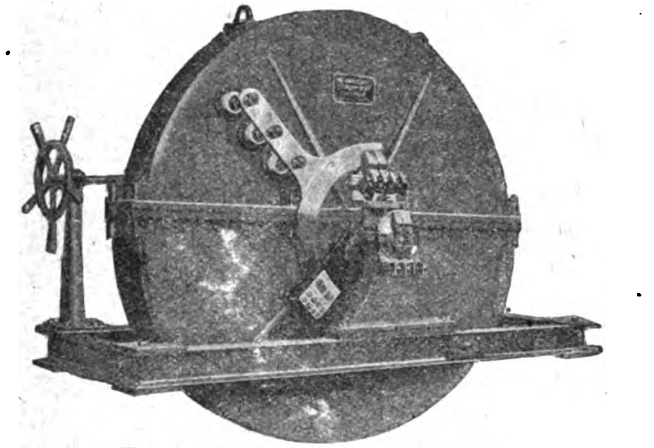


Fig. 1.—Large D.C. Liquid Starter.

of the drum. The drum is provided with two trunnions, one of which bears a brush conveying current to the drum. The rotation of the drum causes the gradual immersion of the dippers in the liquid.

A large number of patterns are made, ranging from the smallest D.C. starters to large sizes dealing with some hundreds of horse-power. In figure 1, for example, which is from a new pamphlet issued by Sandycroft, Ltd. (Chester), is shown a starter for a large D.C. motor worked by a hand-wheel through gearing. A complete line of three-phase starters on the same general principle is also made. Among the special patterns of these made are starters fully enclosed

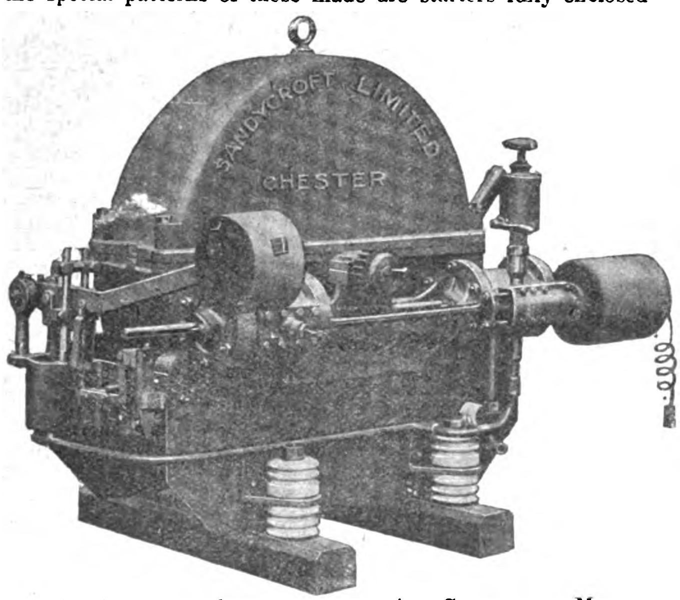


Fig. 2.—Automatic Controller for Air Compressor Motor.

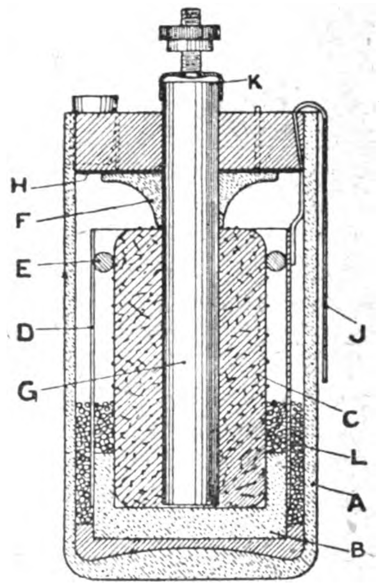
in flame-proof covers and complete outfits combined and interlocked with oil immersed stator reversing switches. The list which we have before us contains very full and well arranged particulars of A.C. starters up to over 1,000 h.-p., the largest of which have several drums and standard D.C. starters up to 600 h.-p. Reversing starters are also made, and the special types include starters for cascade motors combined with all the necessary switch contacts. For work where long-continued running on the resistance is required, such as for winder and haulage motor control, fan regulation, etc., the drum rotates in a cooling tank of water.

Amongst other special applications of the Sandycroft liquid starter is the controller for automatic control of air compressors illustrated in fig. 2. This is worked by a small air-pressure cylinder, in conjunction with a dash pot, controlled by a solenoid operated valve.

Those who are interested in these new developments of a well-tried piece of apparatus are invited to apply for a copy of the descriptive list.

THE EDISWAN "H.2.O." CELL

A FORM of wet cell, with many of the advantages of the dry cell over the ordinary Leclanché without its disadvantages, has been put on the market. The cell may be stored any time without deterioration, and only requires filling with water to be ready for use. A section showing its construction is given in the figure. The porcelain base *B* is held by some bitumen poured into the glass jar *A*. This base forms the support for the sack, *C*, keeping it in a central position, and also a support and spacer for the zinc cylinder, *D*. It is this narrow space between the zinc and the sack which, to a large extent, makes the internal resistance of these cells so much less than that of Leclanché cells. The top of the sack has a rubber ring, *E*, round it, in order to further safeguard against the zinc cylinder touching the sack.



Section of H.2.O. Cell.

Above the sack a porcelain ring, *F*, is slipped over the carbon rod, *G*, and this serves as a support for a waxed cardboard washer, *H*, which supports the sealing compound. Two holes are arranged in the sealing compound and the cardboard washer; in one of these is a fibre tube. This tube forms the funnel through which the water is poured when the cell is required for use, and is normally sealed with a cork. The other hole contains a small glass tube to allow the gases generated when the cell is in action to escape. A lead connection strip, *J*, is soldered to the zinc cylinder, and this is brought up at the side of the cardboard washer and through the sealing compound. The ammonium chloride crystals, *L*, are placed in the cell at the time of manufacture; so that all that is necessary to make the cell ready for use is to remove the cork, fill the cell with water, and replace the cork.

The Induction Generator.—Considering the simplicity of construction and operation of the induction generator, very little practical use seems to be made of it. Yet it is fully as practical as the synchronous generator, its only limitation being that it is difficult to build for very low speeds, such as 100 to 200 r.p.m., and thus at these speeds is expensive, and needs a large wattless magnetising current. Dr. C. P. Steinmetz, discussing the operation of the machine in the *General Electric Review*, says that for speeds of 1,800, 1,200, and 900 the induction generator is well suited, and for the somewhat larger machines, even 720 and 600 revolutions may be employed. Assuming the wattless current of the induction generator to be 50 per cent., then with a non-inductive load induction generators could be used up to twice the capacity of the synchronous machines on the system. If the load has 90 per cent. power factor, about the same capacity as the synchronous machines in induction generators could be used. The output and efficiency of the induction generator is a little *higher* than when the same machine is used as a motor.

THE "ESCO" BUZZER

THERE are a number of situations in which a buzzer is preferable to bells, and their use should increase rapidly now that apparatus of good design is available, such as the new "Esco" buzzer made by the Edison Swan Electric Co., Ltd. (Ponders End, Middlesex).

This buzzer, of which front and side views are given in the illustrations, is designed for quick action, and the contacts are of gold-silver. A phosphor bronze contact carrying a tension spring ensures that instant response to the current is made by the buzzer. This makes it especially suitable for

FIG. 1.—FRONT VIEW OF "ESCO" BUZZER.

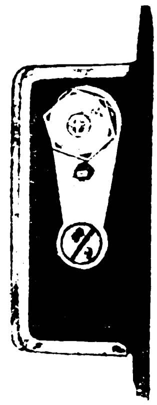


FIG. 2.—SIDE VIEW, SHOWING TONE ADJUSTMENT.

Morse signalling practice. There is an adjusting screw on the outside of the case allowing for about 12 different notes, according to the tension on the springs and position of armature, obtained by the operation of the screw. The coils are wound with enamelled wire. Two standard resistances are made: viz., 2^w and 15^w, but any variation to these can be provided. All parts are nickel-plated but the frame, which is black-enamelled. The buzzer works satisfactorily on any number of dry cells from one to ten; the best results, however, will be found to be obtained with the use of batteries of 2 or 3 cells.

CATALOGUES, PAMPHLETS, &c., RECEIVED

HOLOPHANE GLASSWARE.—Some wonderfully effective illustrations of lighting of railway station premises and railway carriages by metal filament lamps, with their light correctly directed by scientifically designed prismatic glassware, are contained in a booklet from Holophane, Ltd. (12 Conduit Street, S.W.), which also gives particulars of other forms of industrial reflectors developed by the company, and some useful information as to the attainment of efficiency in lighting.

CARBON FILAMENT LAMPS.—L. Andrew & Co. (2 Whitworth Street West, Deansgate, Manchester) send us a leaflet giving prices of "Wrendal" metal filament lamps of British manufacture, and "Capella" carbon filament lamps.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"The A.B.C. Guide to Patents for Inventions." By R. E. Phillips and A. M. Flack. 66 pp. 8¼ in. by 5¼ in. (London: Phillips.) 6d. net; by post, 8d. [A conveniently arranged guide to patent procedure.]

"Dynamo and Motor Attendants and Their Machines." By F. Broadbent. 212 pp. 7½ in. by 5 in. 107 figures. (London: S. Rentell and Co., Ltd.) Eighth edition. 2s. 6d. net; by post, 2s. 10d. [A new edition of a well-known practical work.]

"Alternating Currents in Theory and Practice." By W. H. N. James. 353 pp. 9 in. by 5¾ in. 236 figures. (Cambridge: The University Press.) 10s. 6d. net; abroad, 11s. [A text-book for students not involving much mathematics.]

"The Principles of Electrical Engineering and their Application." By G. Kapp. Vol. I., Principles. 356 pp. 9 in. by 5¾ in. 175 figures. (London: Edward Arnold.) 15s. net; abroad, 15s. 10d. [The first portion of a comprehensive general text-book on Electrical Engineering of a well-known professor.]

LOCAL NOTES

Aylesbury: *Tar Oil Fuel.*—Since August 17 the Diesel engines at the electricity works have been successfully running on tar oil.

Ayr: *Increased Charges.*—The Lighting Committee estimates a deficiency on the working of the electricity undertaking this year of £1,650, and recommends that the charge for current for heating, power, and lighting be increased by 25 per cent. In the case of public lighting the pre-war charge of 2¼d. per unit is to be increased by 60 per cent. Alternative schemes for charging meter rents during the war, and a minimum charge for each consumer, have been disapproved by the Committee.

Barnsley: *New Plant.*—The Chairman of the Electricity Committee has had an interview with the Ministry of Munitions with a view to obtaining certificates for the material required for the extension of the electricity works.

Bath: *Electricity Deficit.*—Although there is a deficit on the working of the electricity undertaking for the year to March 31st of £150, this is a considerable improvement over the previous year, when the loss amounted to £1,500. The improvement, however, is largely due to the fact that £1,600 less has had to be paid in respect of capital charges. On the whole, the result must be regarded as satisfactory, as, but for the reduction on public lighting and the increased cost of coal, there would have been a very substantial profit. As a matter of fact, a deficit of £2,000 was estimated at the beginning of the year.

Bristol: *Large Electricity Profits.*—The accounts of the Electricity Department, which have just been published, show a net profit of £7,912 for the year to March 25th last, to which is added £6,374 balance from the previous year, and £1,436 as a result of an adjustment of income-tax. After meeting the cost of a number of items of expenditure of a capital nature, meters, &c., there is a balance of £9,292, which is carried forward. The question of the true depreciation of the assets of the undertaking in detail has received very careful consideration on a revised basis since the last balance-sheet was prepared, and the result arrived at shows, says the Committee, that the amount included in last year's accounts is sufficient to provide all depreciation requirements to date and is in excess of the statutory provision for the repayment of debt by £76,338. According to the accounts, the total assets are valued at £679,271, and the liabilities at £541,929, making an excess on assets over liabilities of £139,342. The total number of units sold last year increased by 3,463,812 over the previous year. Among other items in the report, it may be mentioned that it has been necessary to postpone the connection of one large consumer requiring 800 kilowatts on account of the lack of plant, and that a large turbine built for the Committee has been commandeered by the Government.

Dewsbury: *Bulk Supply.*—A new agreement has been entered into with the Yorkshire Electric Power Co. with regard to supply in Ravensthorpe. The price agreed is £4 per kilowatt per annum plus 0.65 pence per unit. In addition, for every penny per ton increase in the basis price of coal the Corporation will pay one penny per 400 units, and as the present price of coal is 14s. per ton, the charge per unit at present will be about 0.75 pence.

Glasgow: *Electricity Labourers' Wages.*—The Municipal Employees' Association has applied to the Corporation for an advance of 4s. per week for their members employed in the Electricity Department. The claim affects labourers and semi-skilled workers, and has been referred to a Sub-Committee for consideration and report.

Kirkcaldy: *Proposed Extensions.*—In connection with the difficulty of supplying a large power user in the district, mentioned on page 355 of our last issue, the Council has now decided to obtain a report from Sir John Snell on the general position.

Maidstone: *Electricity Accounts.*—The gross profit on the working of the electricity undertaking last year was insufficient to meet the capital charges by £256. The reasons for this are solely due to the conditions brought about by the war, and include the high price and poor quality of coal, the loss of nearly half the street lighting revenue, the larger

amount spent in wages owing to allowances to dependents and war bonuses to all men employed, etc. The new turbine which it was hoped to have running by January, 1916, was, owing to causes outside the control of the makers, still under erection at the end of the financial year, and thus no benefit was obtained from its great steam economy as had been hoped. Mr. E. E. Hoadley, the Borough Electrical Engineer, has no hesitation in saying that had this set been in operation then there would have been a net profit for the year.

Nuneaton: *High Tension Three-Phase System.*—The Electric Light and Power Committee have had under consideration the installation of high-tension three-phase alternating current plant, and recommend that the necessary arrangements be made. The Committee has been brought to this decision, which the Council has confirmed, by the fact that a large new factory has been built, the owners of which threatened to generate their own power if the Council could not supply them on reasonable terms. Apart from this, however, some big developments are contemplated in the district generally.

Wolverhampton: *Electricity Accounts.*—There was a net profit of £1,856 on the working of the electricity undertaking last year, which has been transferred to reserve fund, making the latter now £13,217. This, however, is a reduction of £4,589 over the figure as it stood at the end of the previous twelve months, owing to expenditure on mains, services and meters for which borrowing powers could not be obtained. The total number of units sold increased by 2,154,426 on the previous twelve months' figures.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The Melbourne City Council requires bare hard-drawn copper cables and insulated cables. Particulars from London agents, Messrs. McIlwraith, McEacharn & Co., Billiter Square Buildings, London, E.C., to whom tenders by September 29th.

Miscellaneous

Midlothian.—The Midlothian and Peebles District Asylum, Rosslynlee, require a six months' supply of electrical fittings. Clerk, 19 Heriot Row, Edinburgh, September 25th.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith and Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £134 to £137 (last week, £131 to £136).

The "Britannia" Lamp.—In future the sale of Messrs. Dick, Kerr & Co.'s "Britannia" Lamp in the United Kingdom will be entirely in the hands of a subsidiary company known as The Britannia Lamp and Accessories Co., Ltd., which will incorporate the existing business of Watlington & Co., Ltd., who have hitherto acted as distributors for the Britannia Lamp in London and the South of England. This change in the selling arrangements does not in any way affect the manufacture of the Britannia Lamp, which will still be made at Dick, Kerr's Preston Works, who will remain responsible for the quality and performance. Any communications in respect to lamps for use in the United Kingdom, however, should in future be addressed to The Britannia Lamp and Accessories Co., Ltd., Britannia House, 48, Milton Street, London, E.C.

APPOINTMENTS AND PERSONAL NOTES

Mr. H. W. Leonard, who for the past six years has held an important position in the G.E.C. Publicity Department, has recently joined up for service with the London Electrical Engineers.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Royce.—The accounts for the year to March 31st, show a net profit of £7,362, which is some £400 more than in the previous twelve months. A 5 per cent. dividend, free of tax, is recommended on the ordinary shares as compared with 2½ per cent. last year, and, whereas twelve months ago £4,000 was added to reserve, nothing is transferred now. At the same time there is a large carry forward.

British Insulated and Helsby Cables.—An interim dividend of 5 per cent. less tax is announced for the June half-year.

Lancashire Dynamo and Motor Co.—An interim dividend, free of tax, of 5 per cent. is recommended on the ordinary shares for the June half-year, compared with 3 per cent. twelve months ago.

Folkestone Electricity Supply Co.—An interim dividend at the rate of 6 per cent. per annum, less tax, on the ordinary shares for the June half-year is recommended.

The Queen Mary Workshop for Disabled Soldiers.—In our article last week dealing with the Queen Mary Workshop for Disabled Soldiers at Brighton we mentioned that Mr. R. Mitchell, of the Brighton Polytechnic, has been responsible for organising the classes and equipment. There is, however, no Brighton Polytechnic, Mr. Mitchell being the well-known Director of Education at the Polytechnic School of Engineering, Regent Street, London, W.

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SUMMARY

A LARGELY attended meeting of British engineering firms, organised by the "B.E.A.M.A.," was held at the Mansion House last week, under the chairmanship of the Lord Mayor. The object was to arrange for the necessary steps to be taken, so that when peace is declared the large amount of engineering machinery which has been installed for war purposes may be used immediately for purposes of ordinary trade. It was recognised that the difficulties with labour might stand largely in the way, but Mr. G. H. Roberts, M.P., a Labour representative, promised to use all his influence to induce the workmen not to insist upon reverting to the pre-war trade union regulations, with a view to assisting output. Other matters discussed related to the appointment of a Ministry of Industry with the object of assisting British manufacturers to obtain orders (p. 366).

THE Board of Trade Committee on Financial Facilities for Trade recommends the immediate incorporation of a British Trade Bank with a capital of £10,000,000 for assisting British manufacturers to develop foreign trade (p. 366).

SOME additions to the discussion on Mr. W. W. Lackie's paper on "Boiler House Design" are given in the Proceedings of the June meeting of the I.M.E.A. (p. 367).

THE annual meeting of the Municipal Tramways Association was held in London last week. Two papers were read, one dealing with the development of goods traffic on tramways, whilst the other pointed to the necessity for the appointment of a Central Traffic Authority in all large towns. A resolution pledging all public bodies to purchase only British-made goods in the future was passed (p. 368).

WE give full details of the scheme for the utilisation of gas for steam raising purposes at the Brighton Electricity Works. The consideration of it has been adjourned until the October meeting of the Corporation (p. 369).

WE publish some German standards which have been issued for the manufacture of pocket-lamp batteries (p. 369).

SOME additional communicated remarks to the discussion on Mr. W. T. Kerr's I.M.E.A. paper on "Application of Electricity to Agricultural Purposes" are referred to, together with the author's reply (p. 370).

AN important decision has been given in the United States Courts upholding the Fleming valve wireless patent (p. 370).

SOME further regulations as to the use of cotton and rubber in cable manufacture in Germany have been issued, pointing to further shortage of these materials (p. 370).

AMONG the subjects of specifications published at the Patent Office last Thursday were electrical ship propulsion, wireless telegraphy, lamp holders, and high-speed telegraph transmission (p. 371).

A LOAN of £4,900 has been applied for at Bedford.—An expenditure of £400 upon cable and switchgear is to be made at Rawtenstall, and sub-station plant is required at Sydney (p. 372).

THE Wigan Electric Light Committee has terminated the appointment of the electrical engineer.—The Aberdeen Corporation recently ordered a new 5,000-kw. set, which, however, will not be ready until the autumn of 1917 (p. 372).

THE Victoria Falls Power Co. last year earned more than sufficient to meet the interest on the 6 per cent. Preference shares, but a dividend on the Ordinary shares is postponed, having regard to the uncertain financial conditions now prevailing (p. 372).

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE, S.W.
ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Platoon Commander Hughes Hallett.
Next for Duty.—Platoon Commander J. O. Cheadle.
Monday, Oct. 2nd.—Technical for Platoon No. 9 at Regency Street. Squad and platoon drill, Platoon No. 10. Signalling class. Recruits' drill, 6.25–8.
Tuesday, Oct. 3rd.—School of Arms, 6–7. Lecture, 7.15, "Development of the Soldierly Spirit," the Adjutant. Range practice.
Wednesday, Oct. 4th.—Instruction class, 5.45. Platoon drill, Platoon No. 3. Range practice.
Thursday, Oct. 5th.—Platoon drill, Platoon Nos. 5 and 6. Range practice.
Friday, Oct. 6th.—Technical for Platoon No. 10, Regency Street. Squad and platoon drill, Platoon No. 9. Signalling class. Recruits drill, 6.25–8.25.
Saturday, Oct. 7th.—N.C.O.'s Class, 2.30, Company Commander Bentley.
Sunday, Oct. 8th.—Entrenching at Otford. Parade Victoria (S.E. & C.Ry.) Booking Office, 8.45 a.m. Uniform, haversacks, and water-bottles. Midday rations to be carried. Railway vouchers will be provided.
Note.—Unless otherwise indicated, all drills, &c., will take pace at Headquarters.
Members who have not yet obtained their Cards of Membership should apply to the Adjutant on Tuesdays or Thursdays.

The Lancashire Linking-up Scheme.—The important scheme for linking up electric power undertakings in Lancashire and Cheshire, referred to on page 207 of our issue for June 8th, has made considerable progress since then. We understand that a concrete proposal has now been submitted to the Local Government Board, the Treasury and the Board of Trade for carrying into effect the arrangements outlined in our previous article. This will be the first instance of taking a definite area of the country and linking up the power stations in it, a plan which holds the field at the moment at any rate, in preference to attempting to deal with the electric power distribution problem by means of the erection of very large new generating stations.

ENGINEERING TRADE AFTER THE WAR

The British Electrical and Allied Manufacturers' Association, which has been keeping before the country generally, and the engineering industry in particular, the necessity for making arrangements for keeping in full use, when peace is declared, the vast amount of engineering plant which has been installed throughout the country for war purposes, organised a meeting at the Mansion House on Wednesday last week with a similar object in view. The Lord Mayor gave the meeting his active support, and the British Engineers' Association, the British Empire Producers' Organisation, and the Engineering and Electrical Sections of the London Chamber of Commerce also took part in its organisation. Mr. C. P. Sparks, the President of the Institution of Electrical Engineers, was on the platform, and the very large attendance contained representatives of the Ministry of Munitions, the Board of Trade, the Foreign Trade Department, the Metropolitan Munitions Committee, North-East Coast Institute of Engineers and Shipbuilders, Society of Chemical Industry, the Engineers' Club (Manchester), Imperial College of Science and Technology, University College, British Association of Trade and Technical Journals, Tramways and Light Railways Association, Association of Electric Power Companies, and the Incorporated Municipal Electrical Association, as well as representatives of many municipal authorities, railway and shipping companies, electric power and traction undertakings, and manufacturing companies from all over the country.

The resolutions passed were as follows :—

1. "That this meeting expresses its appreciation of the great national service rendered by the munition workers of the country, whose patriotic support of our fighting forces on land and sea is hastening the achievement of final victory, and expresses the hope that permanent remunerative employment will be secured in the vigorous economic development of the engineering industry after the war."

2. "That the indispensable military service rendered by the engineering industry, and its fundamental importance in the future as the basis of defensive power and of prosperous economic development, entitle it to special recognition in any reform of a national and imperial commercial policy, and to the patriotic support of all public and private users of plant and machinery throughout the Empire."

3. "That this meeting expresses its general approval of the proposals of the Paris Economic Conference, and recommends that their practical application for the benefit of British industry should be furthered by the immediate appointment of a Ministry of Industry."

Those responsible for the movement have realised that the problem to be faced is of a twofold character; and the speeches dealt with the matter in this way. The two sides of the problem, however, are intimately connected, the one being impossible without the other. It is necessary first of all to arrange that labour shall enter into the spirit of the thing, and assist in every possible way to increase output, because the whole question of regaining our trading position depends upon output. Our knowledge of pre-war trade union conditions renders it impossible to shut one's eyes to the fact that the object aimed at now can never be attained if trade union conditions as we know them are to be reverted to. This brings us face to face with the pledges given so freely, in order to induce the unions to relax their conditions for the period of the war, that these conditions would be reinstated after the war is over. The extraordinary rapidity with which circumstances have changed during the war has already led to the breaking of many pledges not altogether to the benefit of those to whom they were given, and there is little doubt that despite the promises given of a return to pre-war trade union restrictions—for no one can deny that such they were—that is impossible if the Empire is to do what every thinking person knows is necessary. In this case, however, the breaking of the pledge, if it must be put in that way, will be a distinct advantage to the individual workmen, for it is output that is needed, and that of necessity means wages. The inherent distrust of the workman for the employer is obviously the one obstacle to a general agreement, but Mr. G. H. Roberts, a labour representative member of Parliament and a Lord Commissioner of the Treasury, held out a promise of terms being arranged, if the attempt is made at once; for never, he said, were conditions more favourable. Let the employers meet the men fairly, and he would do all in his power to induce them to drop all thoughts of the old trade union conditions. Thus the position as regards the labour aspect of the future trade problem is distinctly promising, and affords a splendid opportunity to the newly formed Federation of British Industries, one of the objects of which is to take labour into its counsels in order that capital and labour may exist in future without that mutual distrust which has so characterised the past.

The other consideration is the means of securing trade, for without these, machinery and satisfactory arrangements between employers and employees will be of little avail. Hence considerable importance attaches to the third resolution, which was moved by Mr. Wilfred Stokes, chairman of the British Engineers' Association. Here again the Federation of British Industries must make its influence felt, for clearly the old order of things as regards British consular and trade representation abroad must receive a thorough overhaul. This is another specific object of the Federation—*viz.* the formation of a Ministry of Industry, managed not by a Government Department, but by a council of representatives of industry. It is calculated that such a scheme, supported of course to the full by the Government, would not cost more than £750,000 per annum, a sum which, though large, is a very small percentage on the pre-war trade of the country.

Having exhorted labour to recognise that from that point of view the needs of the country will be as great after the war as they now are during the war, it follows that employers should be called upon equally to sink selfish motives and join forces in order that, on their part, everything that can be done is done to ensure an influx of orders and steady industrial conditions later on. With this object in view Mr. Stokes urged the various industries to organise themselves to the utmost by all firms joining their respective trade association and so bringing to bear the full weight of their influence in the proper quarters to ensure not only the formation of a Ministry of Industry, but also to insist that the Ministry is formed on suitable lines and that it carries out its work in a manner which will result in the great sacrifices of the war not having been made in vain.

All that remains now is for negotiations to be opened between labour and capital on the one hand and definite proposals to be formulated for securing our share of the world's trade on the other. The Mansion House meeting showed that the B.E.A.M.A.'s efforts have brought us to a point where success in both directions should easily be possible.

A BRITISH TRADE BANK

One of the most definite proposals yet made by a Government Committee for fostering British trade after the war is contained in a report to the Board of Trade by the Committee appointed to investigate the question of financial facilities for trade. This Committee was presided over by Lord Faringdon, and consisted of twelve members, of whom a large proportion are interested in banking. Mr. F. Dudley Docker, of the Metropolitan Carriage, Wagon and Finance Co., who has been mainly responsible for the organisation of the Federation of British Industries, was also a member.

The manner in which German banking institutions have subsidised German trade throughout the world has created considerable feeling on the part of British traders for many years, and one of the first thoughts when questions affecting the future trade of the British Empire came to be considered was as to the best way in which something of the same kind could be adopted in this country. The Departmental Committee on Financial Facilities, which was appointed specially to deal with this matter, quickly came to the conclusion that it will be impossible for British banks to adopt the policy of financing trade concerns which has been a feature of German banks, especially in dealing with foreign trade. Whilst, therefore, leaving it to existing joint stock banks, including Colonial banks, British foreign banks and banking houses to assist traders in a small way, as has been done hitherto, it is felt that there is ample room for an institution which, while not unduly interfering with the ordinary business of banking houses, would be able to assist British interests on the grand scale, so to speak, in a manner that is not possible with existing banking concerns.

The Committee therefore recommends the formation at once of a new bank to fill the gap and to develop facilities not provided at present. This bank, it is recommended, should be called the British Trade Bank, and should be constituted under Royal Charter with a capital of £10,000,000. The first issue should be from £2,500,000 to £5,000,000, upon which, in the first instance, only a small amount should be paid up, but it should all be called up within a reasonable time. The bank should not accept deposits at call or short notice, and should only open current accounts for parties who are proposing to make use of the overseas facilities

which it would afford. There should be a Foreign Exchange Department and a Credit Department, whilst another function of the proposed bank should be to enter into agency arrangements with existing Colonial or British foreign banks. An information bureau for keeping British interests in touch with projects abroad is another recommendation; whilst another sphere of its activities is that any Government assistance given to undertakings in connection with what are recognised as "key" industries should be arranged through the bank.

The committee strongly recommend that the preliminaries for such a bank should be completed before the war is over. Our enemies, they point out, are sure to make, at the earliest moment, strenuous efforts to regain their position in the world of commerce and finance, and it may well be that when peace comes unemployment may be rife at home unless new markets are exploited. It was therefore desirable to ascertain in advance the requirements of foreign countries and the whereabouts of raw materials for our industries.

BOILER HOUSE DESIGN AND OPERATION

SOME additions to the discussion on Mr. W. W. Lackie's paper read at the June meeting of the Incorporated Municipal Electrical Association (see ELECTRICAL ENGINEERING, June 22nd, p. 230, and June 29th, p. 239), have been published in the complete volume of proceedings of the meeting, in the form of communicated remarks and Mr. Lackie's reply to the discussion.

Mr. A. Dow (Detroit), at the request of the I.M.E.A., gives some particulars of the working of the Detroit Edison boilers of 23,654 sq. ft. of evaporating surface per boiler in use at Delray, Connors Creek, and elsewhere. Mr. J. W. Parker, who is responsible for their operation, has made an interesting statement of the difficulties met with and the results obtained in endeavours to reach their upper limit of output both before and during tests made by Dr. J. S. Jacobus. The first trouble was that the baffles between the first and second passes, which were supported in the customary way by iron framing, would not stand the temperature. The remedy was to change the bending of the last row of water-tubes in the first bank and make these tubes carry the baffle tiles. It was also found that no refractory materials on the American market would stand the punishment to which the ignition arches of overfeed or chain-grate stokers, and the low partition wall between the two halves of the first design of furnace were subjected. Underfeed stokers of the Taylor type, which required no brick in these positions, were therefore adopted as standard. A number of ways of constructing the high side walls of the furnaces were tried, and eventually a somewhat soft and porous fire-brick, neither basic nor acid, was adopted, laid to give a slightly concave surface next to the fire. Certain difficulties with the tuyeres of the stokers and with the fans also had to be overcome, and it was finally found at Delray that the limit was imposed by the fact that the damper opening and the curved connection to the uptakes limit the discharge of flue gases, and thereby the amount of coal which can be burned.

Two boilers would, however, serve a 14,000 to 15,000 turbo-generator with its auxiliaries. In the Connors Creek installation this limit was avoided by larger flues. The next limit encountered was due to feed-water, and at Connors Creek the make-up water is all distilled. The limit now being studied is imposed by change in the crystalline structure of the material of the tubes, which receive very severe heat treatment as the gas temperatures reach 2,800° F. or more. Research now being carried out would indicate that a so-called alloy steel will be commercially preferable to a high carbon steel.

In regular practice they work the Connors Creek boilers up to an hourly output of 130,000 lb. of steam per boiler and down to 48,000 lb. per hour before banking; the pressure at the superheater outlet being 225 lb. and superheat 180°. The fuel is a West Virginia, long-flaming, bituminous coal; sulphur content less than 1 per cent., and heat units (taken one year with another) about 13,650 B.Th.U. per lb. as fired, and on occasion, in emergency, the output was pushed up to 204,000 lb. per hour for 20 minutes. There was a clean, thick fire under the boiler when the trouble began. All that was done by the fireman was to open the motor-operated dampers between the boiler and the chimney, speed the motor-driven blower to give the blast, and increase to a relatively *less* extent the feed of coal to the stokers. Of course, the fires were burned thin when the second boiler came into commission, but that was the proper way to deal with such a sudden demand for steam.

Mr. J. Wentworth Parker (Detroit) gives some particulars of the management of the Delray and Connors Creek plants already mentioned. The boilers in question are of the Stirling "W" type, with 23,654 sq. ft. heating surface, with Taylor underfeed stokers and without economisers in the latter installation. The normal evaporation is 32 lb. of water per hour per sq. ft. of boiler-house, of which 28 per cent. is actually occupied by the boilers. The whole of the space between the mud drums is available for furnace area, and the grate area, projected on the horizontal plane, is 42 per cent. of the boiler floor space. Mr. Parker, after a few words as to the completeness of the instrument equipment and the *personnel*, which includes a university-trained combustion engineer in direct charge of the firemen on each watch, gives an analysis of the costs of working realised, which works out to 0·211 cent per kw.-hour metered to feeders in the case of the Connors Creek plant. The average over-all efficiency (ratio of heat in steam delivered to turbine-room) to calorific value of coal as fired is 76 per cent., and the proportion of CO_2 in flue gas gives an average of about 14 per cent. over long periods.

Mr. Horace Boot also communicates some remarks dealing mainly with economies available by extracting by-products from bituminous coal before utilising it for steam-raising purposes. Such treatment would only pay on a large scale, and he suggested that several large electricity undertakings should buy up certain coalfields, put down their own works for producing these by-products, and use the residual fuel and gases for generating electricity.

Mr. H. Martin (Victoria Falls and Transvaal Power Co.) agreed that a good steam meter would be useful in checking losses due to incorrect handling of boiler plant, &c., and asked for Mr. Lackie's opinion as to the reliability and accuracy of suitable types.

Mr. C. Erith (Erith's Engineering Co., Ltd.) refers in his communication to a number of diversely arranged boiler installations employing mutiple retort underfeed stokers, mentioning that in the latest types of these great range of fuels is assured by the travel of the tuyeres being made adjustable and the ash continuously discharged. The same construction was used whether 3 or 30 units or retorts were fitted to a boiler, and no arches were required.

Mr. Yorath Lewis (British Niclausse Boiler Co.) contributes descriptions of several installations of Niclausse boilers, for which he claimed great advantages in the way of overcoming difficulties mentioned in the paper, and in particular in space occupied. For example, the 40,000 to 50,000 lb. per hour boiler for St. Pancras will give an evaporation per square foot of ground space at 134 lb. per hour, although the height to the top of the economiser gas outlets is only 21 ft. Relatively large grate area is another important feature claimed, and the shape and low height permit of excellent day lighting of the firing floors. The efficiency available with the encased type with steel tube economiser is stated to be fully 84 per cent. using 10,500 B.Th.U. fuel.

Mr. C. M. Shaw (Borough Electrical Engineer, Worcester) referred to developments in firing methods which have accompanied the increased use of turbo-generators, and have enabled the capacity of all types of water-tube boilers to be enormously extended. At Worcester he had replaced chain-grate stokers by British-made stokers of the multiple retort entirely underfeed type, having no grates and burning the finest coal without any appreciable riddlings, and he found great advantages in flexibility and range of fuels. At the Westbank station of the Edinburgh Corporation, a similar stoker of the 10-retort size is used on Stirling boilers, each evaporating 40,000 lb. per hour and burning about 2¼ tons hourly in an undivided furnace at the same easy rate of combustion of 5 cwt. per retort as at Worcester.

The most remarkable development of this method is in the new plant of the Buffalo General Electric Co., where there are five Babcock boilers, each with superheater and overhead economiser. Each boiler has only 11,400 sq. ft. heating surface, but has capacity for any load up to 10,000 kw., as the boiler, which is a 3-pass cross-drum Babcock, is raised above a double-ended furnace, and fired at each end by a 15-retort continuous-cleaning stoker; so that, when burning 5 cwt. per retort, the undivided furnace, 25 ft. wide and 16 ft. deep, suffices for the combustion of 7½ tons of coal hourly, without forcing, giving 120,000 lb. superheated steam with the good coal used.

Mr. Lackie, in his reply, expressed his interest in the remarks of several speakers, which, however, only to a slight extent traversed the main contentions of the paper. With regard to the details given by Niclausse boilers, Mr. Lackie remarks that unless the temperature in the furnace is raised by more efficient combustion and the temperature of the outgoing gases lowered by some means (and there is a limit to this), altering the type of casing and economiser will not improve the efficiency beyond a probable stoppage of air leaks. With regard to the question of extraction of by-products from coal, if a supply of waste gas is available, he writes, let us use it by all means, or if coalite or other smokeless fuel would render gas available at a reasonable figure, as is being tried at Brighton, the electric engineer would, no doubt, readily take advantage of any such offer. If, however, the line of development is to be by the way of the gas firing of boilers, and the production and sale of by-products other than gas, it seems to be outside the function of the electrical engineer to be responsible for the production and sale of large quantities of coke and other by-products, and we should not be called upon to bear the cost and to suffer the trouble and inconvenience of the experiments which are likely to be necessary for a considerable time to come before the gas firing of boilers becomes a commercial proposition. The author submits that their hands are quite full with their own legitimate business of the generation

of electrical energy, and to ask them to undertake work which really belongs to the sphere of the practical chemist and the gas engineer is simply to lower their efficiency in connection with their own work. If a ton of bituminous fuel contains, say, 10 cwt. of smokeless fuel, 3½ gallons of spirit, 4 gallons of refined oil, 4 gallons of crude oil, together with a quantity of tar and pitch, and there is only 5,000 cubic ft. of gas available for the firing of boilers, it means that if they are to undertake the production and sale of the by-products they will require to handle two to four times their present quantity of coal. With the data at present before us, the author submits that the capital expenditure, additional labour, and extra accommodation necessary for gas producer plant do not warrant the substitution of gas firing for our present method of burning coal direct in the furnace. The author estimates that, taking everything into consideration, the net result would be an increase of 30 per cent. in the working costs of station as compared with the present method of direct firing. If, on the other hand, coal is used to produce smokeless fuel or coalite, it means handling 4,000 tons of coal per day instead of 1,000, and, in addition to the production and sale of by-products, they would have to dispose of 600,000 tons of smokeless fuel per annum.

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final

QUESTION No. 1,512.

A modern 60-b.h.p., 3-phase, 50-cycle induction motor, 420 volts, 480 r.p.m., with wound rotor, drives with belt a Bailey's single-stage double-acting air compressor, whose capacity is 400 cubic ft. per minute at 35 lb per square inch, running at 160 r.p.m. Cylinder, 375 m/m.; dia. stroke, 350 m/m.; pulley, 60" dia.; motor pulley, 20" dia. There is an automatic valve which stops the motor at 40 lb., and when this pressure drops to 35 lb. it should start again. The valve is working well, but the motor refuses to start, although it takes 120 amps. from the line. If this pressure is dropped to 25 lb. it will start. Why does the motor refuse to start?—Air.

The time for sending in answers to this question, which was numbered 1,510 in error last week, is extended to Thursday, Oct. 5th. The successful replies to No. 1,511 will be published next week.

A Siemens War Savings Association.—Some years prior to the outbreak of war a number of the employees of Siemens Brothers & Co., Ltd., formed amongst themselves a Thrift Club, which has had a successful career. As a branch of the club a War Savings Association has been organised at the Woolwich Works under the name of "The Bowater War Savings Association." Its management is exclusively in the hands of a committee of employees, which committee is solely responsible for exact and regular administration. Since its inception in June last this Association has progressed well, the membership having increased from 500 to about 1,400, and, up to the present, nearly 4,000 War Savings Certificates have been purchased under the Government Scheme No. 2A, by which all subscriptions, as soon as they are paid, are converted into War Savings Certificates, these being allotted to each subscriber in priority of completed subscription as and when the full value has been paid.

ELECTRIC TRACTION NOTES

There was a very good attendance at the annual meeting of the Municipal Tramways Association which was held in London on Thursday and Friday last week. Two Papers were read, the first being by Mr. J. M. McElroy, general manager of the Manchester Corporation Tramways, on "Some Notes on Passenger Transportation in Large Cities." The theme of this was that the expansion of travelling facilities in large towns and cities must take place on the surface and not by means of underground railways, or tramways in subways, or by overhead railways, as adopted in America. In order to give effect to this point of view Mr. McElroy said that it is becoming more and more clearly recognised by all those who are qualified to judge that the public interests are best served by making the facilities for city passenger transportation a monopoly subject to the control of the City authorities, who should possess full powers either to provide and operate the facilities themselves, or, if they think fit, to grant powers to private companies to do so, subject to control and regulation in the public interest. The world's experience has shown that every city should have a permanent authority directing the initiation and carrying out of all schemes for new transit facilities, in order that there may be continuity of policy, and that the future needs of the city and the surrounding districts over a wide area may be properly looked after. The view was expressed that travelling facilities should not be looked upon so much as a commercial undertaking as one meeting an essential need of the public. It is pointed out that in New York the companies operating the underground and elevated lines work in conjunction with the City authorities, the arrangement being that the companies get their operating expenses and 6 per cent. interest, whilst out of the balance the City gets the interest on its investment, plus one per cent. for sinking fund, any balance after these payments have been made being divided equally between the two parties. It is doubtful, however, whether there will be an available net revenue to meet the interest and sinking fund payment on the City's expenditure, but the City authorities are not looking for profits, and so important a duty on the part of the municipality do they consider the provision of travelling facilities that they have made up their minds to carry out the work properly, even if it entails a charge upon the rates of the city. In this way a thoroughly co-ordinated scheme is being provided. In London, on the other hand, where all the capital for the underground railways has been found by private enterprise, the amount available for dividends on the ordinary capital in 1918 was only sufficient to pay just over 2 per cent., and it was not at all likely that private enterprise would be willing to shoulder the great outlay involved in the provision of underground facilities in the future.

The second Paper, by Messrs. G. W. Holford, general manager of the Salford Corporation Tramways, and W. Clough, general manager of the Bury Tramways, discussed the utilisation of tramways for goods traffic, and commented upon the fact that although this matter was first brought prominently to notice as far back as 1904, only a very few towns have developed their tramway undertakings in this direction. Particulars are given of the goods traffic arrangements at Burnley, Glasgow, Huddersfield and Leeds; but, although it is not mentioned in the paper, most tramways undertakings have powers of this nature which have not been acted upon. Lancashire is regarded by the authors as particularly suitable for such a development, for no other county has such a network of tramways as those which connect the industrial towns of the County Palatine, or could derive more benefit from the utilisation of tramways for the conveyance of goods, if this were practicable. The continuous network of tramways in Lancashire now amounts to some 403 route miles. After giving a description of the Bradford trolley-battery goods vehicle, described and illustrated in Electrical Engineering for May 25th, page 193, the authors sum up their conclusions by calling attention to the remunerative character of the conveyance of goods and the absence of difficulties in the way of interchange, having regard to the manner in which through running for passengers has been dealt with, and suggest that the work should be undertaken by a Joint Board representing particular areas.

At the annual business meeting on Friday Mr. H. Mozley, general manager of the Burnley Corporation Tramways, was elected president for the ensuing year. A discussion took

place upon a recommendation by the Council that all Government departments, local authorities and statutory bodies entrusted with the control of moneys raised by taxes or rates should be under legal obligation to purchase, so far as possible, only goods produced within the British Empire. The proposal was received with general consent, although some members saw in the recommendation the possibility of restrictions being placed upon the business activities of municipal tramways. An amendment to delete the paragraph from the report was negatived by a large majority. It will be remembered that the same objection was taken to a similar resolution at the I.M.E.A. Convention this year.

Tramway undertakings throughout the country will be interested in a decision given at the North Staffordshire Munitions Court last week, in which it was held that a tram conductor employed by the Potteries Electric Traction Company, who was formerly a potters' printer, does not come under Section 7 of the Munitions Act. Consequently the Tribunal granted the man's application for a leaving certificate, which, however, was strongly opposed by the company on the ground that tramway facilities are necessary to the manufacture of munitions and that both male and female conductors come within the Act. The Court gave the tramway company leave to appeal to the Central Munitions Court on the point of law, although it was added that the decision was also governed by the fact that the company were not paying the man a proper rate of wage. It appears that the man left the company's employ a short time ago, but returned again later, when he was paid 5d. an hour instead of 6d., which he received formerly.

The question of introducing some form of electrically propelled vehicle for use in Simla is, says *Indian Engineering*, once more engaging the attention of the municipality. The electrical engineer has been instructed to submit specifications for an electrical jinrickshaw, based on suggestions made in a note by Captain Batty in the report of the Simla Improvement Committee. The postal department is to be asked to give a trial to this type of vehicle for the conveyance of mails, and it is also in the minds of the Corporation to ask private firms to undertake the hiring of them out for the use of the public.

THE BRIGHTON POWER GAS SCHEME

AT the annual meeting of the Incorporated Municipal Electrical Association on June 22nd, Mr. J. Christie, the Borough Electrical Engineer at Brighton, aroused considerable interest when he indicated that the Brighton Electricity Committee had under consideration a proposal to enter into an arrangement with a company by which gas would be used for firing some of the boilers at the Southwick power station. The scheme contemplated is with the British Coalite Co., and the matter came before the Corporation on Thursday, when further consideration was deferred until the October meeting. Although the low temperature carbonisation process of the British Coalite Co. has not met with a great amount of commercial success hitherto, it is generally recognised that the difficulties have not been on the technical side so much as on the financial. With the stimulus towards a greater use of gas for steam-raising purposes which is being given by the Fuel Committee of the British Association, however, there seems every prospect of the process realising the early hopes which were entertained for it. The Yorkshire Electric Power Co. is also entering into arrangements with the British Coalite Co. for the erection of similar plants at collieries in their area, and central station engineers throughout the country will watch these experiments with the greatest interest.

The Brighton scheme provides for the leasing to the British Coalite Co., for a term of 25 years, of six acres of land adjoining the power station, at an annual rental equivalent to the interest and sinking fund charges on the capital outlay, which are put at from £60 to £100 per annum. On this site the company, at their own expense, will construct a wharf and other works for carbonising 200 tons of coal per day, and it is estimated that the first installation of the plant will yield, in addition to coalite, a form of smokeless fuel, and other bye-products, such as tar, sulphate of ammonia, benzol, toluol, and light and heavy oils, approximately 4,800,000 cubic feet of gas per day. It is proposed that the Corporation should purchase this gas from the company at a low figure, and by adapting a portion of their existing boiler plant at a comparatively small outlay for firing by means of gas instead of coal, in this way utilise the waste heat contained in the gas for steam raising. The Corporation, under the proposed agreement, undertakes, as far as their load permits, to utilise this gas to its fullest extent in preference to solid fuel, and would pay by meter at the rate of 1·5d. per thousand cubic feet with coal at 20s. per ton as a basis, subject to an increase or decrease at the rate of 5 per cent. for each shilling per ton that the cost of coal varies above or below this figure. In addition, the Corporation will supply the company with electrical energy at 0·6d. per unit with coal at 20s. per ton subject to the same variations. This virtually means that the electricity at present used at the works will be used instead for driving the machinery on the Company's premises and be paid for by them, thus affording an additional source of revenue to the electricity undertaking. The agreement contemplates the adaptation of three of the present boilers for burning gas, and it is estimated that the removal of the present grates and the substitution of burners can be carried out at a cost of about £750. Two out of the three boilers would be used almost continuously, and steam would be raised by coal only on such of the remaining boilers as are required to meet the peak load.

Mr. Christie, in his report, puts the saving in the Electricity Department at about £5,000 per annum if this arrangement is adopted, and, in addition, there would be further savings due to reduced labour in trimming coal, removal of ashes, and a general cleanliness of the boiler-house and station, whilst radiation and stand-by losses would also be effected. The British Coalite Co.'s first plant of this nature is being erected at Barugh, near Barnsley, in the Yorkshire Electric Power Co.'s area, the arrangements between the power company and the British Coalite Co. being similar to those set out above. Furthermore, it is understood that the Government have taken a substantial proportion of the debentures of the Coalite Co. Already one boiler at the Yorkshire Electric Power Co.'s works is being fired by means of fuel gas, and Mr. Christie reports that on the occasion of a visit by himself it was doing its work admirably.

Appended to Mr. Christie's report are some notes by Mr. W. B. Woodhouse, the Chief Engineer of the Yorkshire Electric Power Co., who gives the Brighton scheme his hearty support and expresses the opinion that Mr. Christie's estimates are on a conservative basis. At the same time, he points out that there is some risk in this matter, such as is inseparable from all new undertakings, but it is not apparently a risk from which he thinks supply undertakings, either company or municipal, should shrink.

When the report came before the Corporation on Thursday there was considerable discussion, and eventually the debate was continued in camera. Several speakers wanted further details and more time to consider the proposals, and eventually it was decided to postpone the further consideration of the report until the October monthly meeting. Meanwhile, members of the Corporation desiring further enlightenment are requested to apply to the Electricity Committee.

GERMAN STANDARDS FOR POCKE LAMP BATTERIES

THE following standards for three-cell dry batteries for pocket lamps have been issued by the *Verband Deutscher Elektrotechniker* (in conjunction with the German Association of Pocket Lamp Battery Makers):—

The standard pocket lamp battery must (without contact springs) have the following dimensions: Length, 62 mm.; width, 21 mm.; height, 65 mm. Deviations of ½ mm. in the length and width, and 1 mm. in the height, are allowable.

The contact strips must be made of suitable incorrodible springy metal 7 to 8 mm. wide. The shorter strip must be 18 to 20 mm. long, and the longer strip 40 to 45 mm. long.

The battery must be closed or sealed at the top with an approved material.

Every battery must bear a legible indication of its place of manufacture and must be clearly and indelibly marked with the week and year of manufacture.

The E.M.F. of the battery must, on delivery from the factory, be between 4·5 and 4·8 volts, and must not fall below 4·2 volts after 14 days from delivery to the customer, or at the latest 4 weeks from sending out from the factory, provided that it is properly packed and handled in the meantime. For this measurement a precision voltmeter of at least 100 ohms per volt must be used.

The internal resistance of a freshly made battery must be such that the voltage on a circuit of 15 ohms resistance does not drop more than 0·6 volt below 4·5 volts.

On every battery must be marked the output in hours of burning for continuous and for intermittent working. These particulars are to relate to the battery as delivered from the factory and temperature of about 20° C. For the continuous run the battery is to be tested on an external resistance of 15 ohms, and the battery is to be considered run out when the terminal voltage drops to 1·8 volts. The intermittent rating is to be 40 per cent. above this, and may be rounded off to the nearest ½ of an hour.

THE APPLICATION OF ELECTRICITY TO AGRICULTURAL PURPOSES

THE discussion on Mr. W. T. Kerr's paper on the application of electricity to agricultural purposes read at the June meeting of the Incorporated Municipal Association is concluded by the publication in the Association's proceedings of some communicated remarks. The paper and discussion were reported in ELECTRICAL ENGINEERING, June 20th, p. 245.

Mr. W. Low (Marykirk) contributes a few notes on his experience of a small water-power installation providing current within a radius of 2,000 yards of overhead lines, except where underground lines are necessary through a wood. The overhead line is of hard drawn copper on poles at an average distance of 65 yards apart, 16 ft. from the ground. Electricity is used for lighting buildings and cottages and for threshing, for which purpose he finds a 15 h.p. motor running at 660 r.p.m. ample to drive the mill and the straw-carriers which convey the straw to the barn. He reckons the power required for this work averages 10 h.p. Mr. Low also uses electricity to operate a cream separator in the dairy. The electric motor, he continues, presents very great advantages over the steam engine or the oil engine. No time is lost in preparation, no man is needed to fire the boiler, to start the engine, or to stand by the lamp while the oil engine is running, and the motor can be easily stopped should an accident take place. The only precaution desirable is to run the motor for half an hour at a time during wet weather to keep the insulation dry and in good condition. Mr. Low has not tried electric ploughing, and has some doubts about the feasibility. He would not recommend the battery-driven wagon to pull the plough, and the cost of erection and maintenance of conductors at every fence on a farm would be great for a seasonal purpose, and very ugly. He has had good results in converting timber, using a 15 h.p. motor to drive a band saw. Besides lighting, Mr. Low uses electricity for heating by means of radiators; these can be used at night when there is no other load on the turbine, and he has found it most convenient to have fans for ventilating purposes. He has also a cold-storage plant driven by a 2½ h.p. motor, which by working for five hours twice a week keeps the chambers cool and makes 1 cwt. of ice 56 lb. at a time. A 1 h.p. motor driving a mangle in the laundry allows the laundrymaid to fold while the mangle is working, and saves a day's work in the week. Mr. Low has experimented with electro-culture for six years, and while he is satisfied that it increases the crop under certain conditions, he has not been able to show the cost. He has experienced trouble through the electrified air under the overhead network being carried away by the wind. To intercept a part of this drifting electricity, he erected a wire netting screen 16 feet high, made of ½-inch mesh wire netting. This extended 10 yards beyond the overhead network at either end, and was placed parallel to it between the trial and control plots, but it is of little use when the wind is blowing directly on to the control. It may help when the wind is parallel, or nearly parallel, to the screen. The most satisfactory result he obtained was in 1914, with hay. A difference of 20 per cent. was observed on two different pairs of plots; but that year was an exceptional one, because during the time the excitation was applied the wind was continuously southerly, and blew from the control to the trial plots.

Mr. B. A. Tapp also communicates some remarks. The British farmer, he says, welcomes electrical methods, and is willing to pay for the supply at rates which make him a very profitable customer to the supply authority. He therefore urged supply authorities to standardise the carrying out of farm services and tariffs, and to enlist the co-operation of agricultural machinery manufacturers. He enlarged also upon the possibilities of diminishing our necessity for importing eggs by the adoption of electrically-heated incubators on a scale producing a supply load worth catering for.

Mr. Kerr, in the course of his reply, refers to assistance to the railway companies that might be rendered by the use of electrically-worked milking appliances, which, he says, would enable the milking to be carried on at the same hour all the year round, and the running of earlier milk trains to ease the congested morning traffic. This, he thought, was a point worth noting and putting to a railway company when a supply authority is endeavouring to get wayleaves. The point of reduction of fire risk mentioned by Mr. Woodhouse in the discussion had been realised by farmers in the Hereford district; in fact one farmer had so high an insurance premium to pay that on conversion to electricity the reduction on one year's assessment defrayed the cost of the electrical equipment.

With reference to Mr. Low's underground line through a wood, they had had as yet no occasion to go through woods in the author's district, but where they come across trees of any size they obtained permission to lop any branches that were likely to touch the wire. It was found from experience that stranded aluminium wire was preferable to copper. It was so much easier to handle that the overhead gang always asked for it in preference.

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

News has reached this country of an important decision in the United States Courts in connection with a patent action, which has been occupying a good deal of time, brought by Marconi's Wireless Telegraph Co. against Dr. Lee De Forest, there being also a counter-claim by De Forest claiming damages for infringement by the Marconi Co. The action concerns the Fleming Valve and the De Forest Audion, and judgment has been given in favour of the Marconi Co. The Court declared Dr. Fleming's patents to be master patents, and not anticipated by De Forest or anyone else. According to the *Financial News*, the Atlantic Communication of America, a subsidiary company of the Telefunken Co., of Berlin, has infringed a number of patents in order to obtain a possible wireless service across the Atlantic, and, fearing the action by the Marconi Company against them, which is pending, recently purchased the De Forest patents for the sum of about £30,000. Dr. Fleming's valve and many infringements of it have been largely responsible for the developments in the reception of wireless telegraphic messages over long distances. It was the introduction of these "valves" which gave a value to the Poulsen system, and has been principally responsible for such success as the Germans have obtained, both abroad and at home, in wireless telegraphy. The experiments recently carried out in wireless telegraphy in the United States, which gave sensational results, were achieved solely by the use of the Marconi Co.'s Valve patents.

WAR TIME CABLE STANDARDS IN GERMANY

SOME further regulations relating to the manufacture of cables and wires in Germany owing to the shortage of materials have been issued by the *Verhund Deutscher Elektrotechniker*.

In the case of rubber-insulated zinc and aluminium conductors, from 16 sq. mm. section upwards a serving of cotton is not to be used over the rubber. Zinc and aluminium cables, with rubber insulation must, instead of having a covering of rubber or impregnated tape over the rubber insulation, have a covering of paper. Flexibles are struck out entirely from the standards, and must not be made.

A further note remarks that these regulations are to prevent unnecessary waste of cotton and reclaimed rubber (Gummiregenerat), and that further economy than actually specified should be practised if possible. The avoidance of tube-encased wiring is, for example, enjoined.

An alteration in the standard of copper has also been made, a resistance of 20 ohms now being allowed for a conductor 1 kilometre long of 1 sq. mm. cross section at 20° C.

TUMBLER SWITCH CONTROLS

A NEW booklet describing the great possibilities opened up by the use of various combinations of different patterns of tumbler switches has been issued by A. P. Lundberg & Sons (Pioneer Electrical Works, 477 to 489, Liverpool Road, Islington, N.) This is a subject which has been developed largely through the efforts of this firm, who have brought out a number of special patterns of multiple way and other switches, and devised combinations of them opening up possibilities of lamp control, from the comparatively simple methods of switching lamps on and off from various alternative points to highly ingenious arrangements of master switches, point switches, etc. The booklet contains a series of new and very clear diagrams, enabling the types of switches, the purpose and effect of and the number of wires required for any given control to be seen at a glance. At the end are two amusing imaginary dialogues, which bring out very forcibly that the economy and convenience of suitable lamp control has only to be known to be appreciated. Both technical and non-technical people will be interested to have information on this subject in such a convenient form, and will be struck in particular at the clever diagrams showing the enormous amount of walking about to and from switches that may be saved by taking advantage of the control systems described.

"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published September 21st, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

12,444/15 **Ship Propulsion.** BRITISH THOMSON-HOUSTON CO. (*G.E. Co., U.S.A.*). A method of electrical propulsion of ships in which an alternator, driven by the main prime mover, supplies current to a pair of induction motors on the propeller shaft. One motor has a short-circuited secondary winding of low resistance. The other motor has its primary wound for two numbers of poles, and is provided with means whereby the secondary resistance is increased when connections for reversing are made. Both motors are employed when running full speed ahead, and the second motor only arranged for increased torque for going astern. Where high economy at cruising speeds is desirable, the motor with the short-circuited low-resistance winding is arranged for pole changing.

12,536/15. **Wireless Telegraphy.** T. F. WALL. This specification deals with means for producing high-frequency currents, and covers the combination with an oscillatory circuit containing a pair of condensers in series, one of which serves as a spark gap; of another oscillating circuit in conjunction with the gap, the circuit being so adjusted that the current across the gap, which is the resultant of the currents in the two circuits, exhibits the phenomenon of "beats." A magnetic blow-out field may be provided.

4,575/16 (*101,250*). **Lampholders.** J. SALT. A lampholder with no metal parts other than the terminals, consisting of a combined bayonet-socket and body of porcelain or other material in one piece, provided with two tubular passages for the terminals, a central aperture, and a cap integral with the body.

9,193/16 (*101,278*). **Telegraphy.** W. J. MELLERSH-JACKSON (*Western Union Telegraph Co.*) A transmission system for very high speed working, comprising a transmitter having, in combination with a polarised transmitting relay, a source of current supply by one pole connected to opposite contact points of the transmitting key, and the other pole connected to return, the key itself being also connected to return and the core of the relay being in a circuit bridged across the two conductors leading to the opposite contact points of the transmitter. This bridged circuit contains a resistance in parallel with a condenser, so that when the key breaks contact with one contact point the condenser discharges and energises the magnet of the relay, reversing the position of its armature. The condenser recharges with current of opposite polarity when the transmitter key completes contact with the other contact point.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Dynamos, Motors, and Transformers: BRESLAUER [Unipolar dynamo-electric transmission] 8,334/15; DUFTY [Regulation of output of variable-speed machines] 13,283/15.

Heating and Cooking: GROGAN and BURDER [Electric cooking apparatus and switchgear therefor] 12,984/15.

Incandescent Lamps: BRITISH THOMSON-HOUSTON CO. (*G.E. Co., U.S.A.*) [Incandescent lamps] 12,792/15.

Instruments and Meters: CROZIER and WHELLER [Testing apparatus] 12,644/15; H. ALLEGRANZA [Connection of accumulator plates] 6,044/16 (*101,321*).

Storage Batteries: OLDHAM [Washing apparatus for use in connection with storage batteries] 12,936/15; VANDERVELL [Portable battery lamps] 16,731/15.

Switchgear, Fuses and Fittings: DAY [Combined lamp-holder and detachable shade support] 15,222/15; McINDOE [Switch plugs] 15,427/15; MARKT [Cord grip holder] 17,480/15.

Telephony and Telegraphy: ROUZET [Polyphase generator for high frequency currents with polyphase tuned spark gap] 519/15; CARDWELL [Printing telegraphs] 8451/15 and 8,211/16 (*101,329*); WESTERN ELECTRIC CO. [Automatic telephone system] 3,758/16 (*100,198*), and [Call distributing telephone systems] 7,258/16 (*100,535*).

Traction: SMITH and ROBINSON [Vehicle lighting] 12,781/15.

Miscellaneous: SOC. ANON. DES ETABLISSEMENTS L. BLERIOT [Regulation of electrical installations] 24,629/14; WALTER McGEE & SON, LTD., and WALLS [Coil-winding machines] 11,412/15; TAYLOR and HERD [Lighting of gangways of cinematograph theatres] 12,590/15; GREVILLE [X-ray apparatus] 15,057/15; BRONSTED, HELLESENS, ENKE and V. LUDVIGSEN [Primary cells with zinc anodes and alkaline electrolyte] 16,471/15; BEAUMONT [Batteries] 16,516/15; R. W. SANDERS [Portable electric gas lighters] 8,285/16 (*101,330*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Telephony: V. G. WERNER and K. H. WARFVINGE [Communication with moving trains] 11,658/16 (*101,343*).

Miscellaneous: SOC. D'ELECTRICITÉ NILMELIOR [Electric machines] 12,063/16 (*101,344*).

Expiring Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: SIEMENS BROTHERS & CO., LTD., H. W. HANDCOCK, A. H. DYKES, and J. J. RAWLINGS [Metal-cased conductors for interior wiring] 13,220/09.

Dynamos, Motors, and Transformers: M. WALKER [End connections of turbo-alternator rotors] 13,078/06.

Electrometallurgy and Electrochemistry: F. E. RICHARDSON and J. A. VAUGHAN [Electrical treatment of gases] 13,342/07; M. RUTHENBURG [Electric furnaces] 12,408/08.

Ignition: F. R. SIMMS [Magnetos] 11,773/05.

Incandescent Lamps: A. JUST, F. HANAMAN, and VEREINIGTE ELEKTRICITÄTS A.G. [Metal filament made by deposition on a carbon core] 11,949/05.

Switchgear, Fuses, and Fittings: BRITISH THOMSON-HOUSTON CO. [Oil-switch, tank lowering gear] 11,970/05.

Telephony and Telegraphy: A. POLLÁK [Telegraph perforator] 11,903/05.

Miscellaneous: J. P. NORTHEY [Electrically-worked siren] 13,200/06.

Obituary.—The death has taken place at Llandudno of Sir George Franklin at the age of 63 years. Sir George is probably best known, at any rate in London, as President of the National Telephone Co., although he leaves behind him a great record of work done in the municipal life of Sheffield, extending over a period of some 38 years. He was the first elected Lord Mayor of Sheffield. It was in 1892, when he negotiated the sale of the Sheffield telephone business to the National Telephone Co., that he became associated with the latter as director, occupying subsequently the position of Vice-President, and finally President.

Wiring Contractors' Dispute.—The dispute between the Liverpool Master Builders' Association and the Liverpool Branch of the Electrical Trades Union, which has been in existence for a long time, has been referred to arbitration. The arbitration proceedings are now being held in Liverpool.

An Electric Boiler Scaler.—The Comptroller of Patents has granted Messrs. J. C. McQuitty, Ltd., engineers and millwrights, of Belfast, a licence to use a German patent known as Van Deevorde's Patent for carrying out scaling operations on boilers electrically. The firm in question will manufacture the apparatus, paying a royalty of £1 per machine sold.

The I.M.E.A. Proceedings.—The Proceedings of the 1916 Convention of the Incorporated Municipal Electrical Association have now been published at the usual price of 5s. They contain a full report of the papers and discussions, together with the authors' replies, for which there was not time at the meeting, and a number of communicated remarks to the various discussions. There is also a list of members, &c.

Shellac.—The Ministry of Munitions has made the statement that in view of the excessive rise in the price of shellac, both in London and Calcutta, and in consequence of speculation, the British and Indian Governments are considering what steps should be taken to put a stop to this inflation of price.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The Sydney Corporation require for the Castlereagh Street Sub-station, converter plant for converting 3-phase, 50-period, 5,000 volts to 480/240 volts continuous current; storage batteries with end cell regulating switches; booster plant for battery charging, also a milking motor-generator set and low tension continuous current switchboards. The specification may be consulted at 73, Basinghall Street, E.C., and tenders to Town Clerk, Town Hall, Sydney, by Jan. 22nd.

Bedford.—Application has been made to the Local Government Board for sanction to a loan of £4,900 in respect of new plant.

Rawtenstall.—An expenditure of £400 is contemplated upon cable and switch gear.

LOCAL NOTES

Aberdeen: *Satisfactory Working of 3,000-kw. Set.*—In his annual report, the main figures of which were given on page 346 of our issue for Sept. 7th, Mr. J. A. Bell, the City Electrical Engineer, states that the 3,000-kw. turbo-alternator installed a short time ago has generated 30,129,900 units out of a possible 34,061,260 output of the works. The machine has been a most reliable and economical unit, and had it been otherwise, continuity of supply could not have been satisfactorily maintained. The Council has recently placed an order for a 5,000-kw. set, which, however, will not be ready for service until the autumn of 1917.

Gillingham: *Electricity Deficit.*—There was a loss of £1,253 upon the working of the electricity undertaking last year.

Rochdale: *Extensions Postponed.*—We mentioned a short time ago that although the expert advisers to the Corporation recommended an expenditure of £50,000 upon extensions of the electricity undertaking, there was a general feeling that such a large amount should not be spent during the war. The Electricity Committee has now reported to this effect. A sum of £10,000, however, is available for meeting the immediate needs of the undertaking.

South Shields: *Electricity Accounts.*—**It has been necessary to draw upon the reserve fund to the extent of £1,961 in order to meet the deficit on the past year's working of the electricity undertaking. Fortunately, the Committee has a substantial reserve fund, the amount still standing to the credit of which is nearly £15,000. The total revenue shows a decrease of £3,745 over the previous year, the revenue from both private and public lighting having dropped very considerably. But for an increase of £1,172 in the revenue from power purposes and an increase in the income from heating and cooking supplies, the position would have been worse.**

Walsall: *Position of Electricity Undertaking.*—Notwithstanding that the Electricity Committee anticipate a considerable loss on the present year's working of their undertaking, as a result of the transfer from the old to the new power station, it has been decided not to increase the charges, but if necessary to make a call on the rates for any deficit at the end of the year. In arriving at this decision the Committee explain that they did not regard any deficit this year as a loss in the ordinary sense of the term, as it would arise solely on account of capital charges on generating plant which has not yet come into use. Furthermore, it was regarded as suicidal to increase charges at the present time, as the Committee consider they are too high already.

Warrington: *Electricity Profits.*—There was a net profit of £2,395 on last year's working of the electricity undertaking. There has been a large increase in consumption of current for power purposes in connection with munitions, and there still remain many demands for power for this purpose to be met. The boiler plant is being extended by the addition of a water tube boiler, mechanical stokers, economiser, coal bunkers, and coal-handling gear. In connection with supply for munitions purposes, the Sales Department has been very active in installing motors, the turnover of £4,540 being by far the largest yet attained.

Wigan: *Changes in Electricity Department.*—The Electric Light Committee, reporting upon a recent breakdown at the generating station, regret that it is imperative to terminate the appointment of the electrical engineer. In doing so the Chairman said that until quite recently he had had the greatest confidence in the ability of the management, and that the course he was now compelled to take as a result of the decision of the committee was a most displeasing one. The minutes of the committee were carried unanimously, notwithstanding that one member of the Corporation thought the Committee had been too precipitate in the matter, and ought to have waited until the report of the Enquiry Committee had been brought before the Corporation.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £137 to £139 (last week £134 to £137).

Concordia Electric Wire Co.—The Public Trustee informs us that a British syndicate has purchased the shares of the Concordia Electric Wire Co., Ltd., vested in him under the Trading with the Enemy Amendment Act, 1916, and pending the reconstitution of the Board of Directors of the Company no orders will be recognised by the Company unless they are issued on the official order forms of the Company signed by Mr. R. Belcher, one of the existing Directors of the Company, and countersigned by Mr. Leonard Thornton, the Secretary.

APPOINTMENTS AND PERSONAL NOTES

Mr. E. W. Abbott has taken over the management of the Newcastle Branch of Messrs. Crompton and Co., Ltd., at 21, Pearl Assurance Buildings, Northumberland Street, Newcastle-on-Tyne. For many years he has been in charge of the contract department at Chelmsford, and has carried out the electrical equipment of many important main winders, rolling mills, coaling cranes, large haulage gears, etc. Mr. Abbott was also responsible for the design and equipment of many of the early central stations in this country.

There are vacancies for an electrician and an improver. (See an advertisement on another page.)

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Clyde Valley Electrical Power Co.—At the annual meeting last week, when the report and accounts given in our issue for August 31st were adopted, it was stated that the contracts in hand for supply show an increase for the June half year of 4,403 h.p. over those of the corresponding period of 1915, whilst the connections to mains show an increase of 7,544 h.p. It is expected that the new power station at present under construction near Cambuslang will be in operation at the end of October.

Dick, Kerr & Co.—The dividend on the 6 per cent. preference shares is declared for the June half year.

Victoria Falls Power Co.—At the annual meeting last week Mr. A. E. Hadley, who presided in the absence of the Marquis of Winchester, still on active service, called attention to the fact that the company has now reached a stage when the earnings exceed the amount necessary to meet the interest on the 6 per cent. preference shares, but, having regard to the uncertainty of all financial conditions, the Board consider it necessary to conserve, as far as possible, the resources of the company. Hence no dividend was declared on the ordinary shares. If, however, revenue continued at the present rate and taxation was not further increased, the ordinary shares should receive a first distribution next year, when a reserve fund would also be inaugurated. As, since the outbreak of the war, the German debenture holders have not been able to collect their interest, the sum of £287,961 stands to the credit of a suspense account.

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SUMMARY

THE question of the automatic operation of mine hoists, the extent to which it is feasible, and the characteristics essential in the driving motor, whether steam or electric, are problems discussed in a paper read last month by Messrs. H. Kenyon Burch and M. A. Whiting before the American Institute of Mining Engineers (p. 374).

THE report of the Shareholders' Committee of the Metropolitan Electric Supply Co., reconstituting the Board, was passed at an extraordinary general meeting and subsequently confirmed at the adjourned annual general meeting on Friday (p. 376).

THE electricity undertaking of the Borough of Bethnal Green, which takes current in bulk from Stepney, will be inaugurated to-day (p. 376).

WE publish some interesting information with regard to the difficulties that have been experienced in obtaining wayleaves for carrying overhead transmission lines. The case for legislation is a strong one, and all sections of the electric supply industry are urged to co-operate in order that any proposal made to Parliament may be absolutely unanimous (p. 377).

A RAIL corrugation planing machine which originated in Australia is working some important contracts in this country (p. 378).

THE improvement of the power factor of a power transmission system is dealt with in our "Questions and Answers" columns (p. 378).

A NEW design of locking lampholder is described and illustrated (p. 379).

AMONG the subjects of specifications published at the Patent Office last Thursday are constant voltage regulation, cinema theatre lighting, testing sets, vehicle lighting, and metal filament lamps (p. 380).

THE communicated remarks forming the conclusion of the discussion on Mr. Ellis's paper on "The Relative Economy of Generation of Electricity on a Small Scale on Taking Bulk Supply" are published in the Proceedings of the annual meeting of the I.M.E.A. (p. 380).

FURTHER increases of charges are being made by a number of electricity departments (p. 381).

GENERATING plant estimated to cost £45,246 is to be installed at Sunderland, and cable (£2,929) at Hampstead. Metal and carbon filament lamps are required by the Mersey Railway Co. (p. 381).

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE, S.W.
ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Platoon-Commander J. O. Cheadle.

Next for Duty.—Platoon-Commander A. Gerard.

Monday, Oct. 9th.—Technical for Platoon No. 9 at Regency Street. Squad and platoon drill, Platoon No. 10. Signalling class. Recruits' drill, 6.25 to 8.0.

Tuesday, Oct. 10th.—School of Arms, 6.0 to 7.0. "Organisation and Discipline." Lecture at 7.15. Coy.-Cmdr. W. Hyman. Range practice.

Wednesday, Oct. 11th.—Instruction class, 5.45. Platoon drill, Platoon No. 1. Range practice.

Thursday, Oct. 12th.—Platoon drill, Platoon No. 7. Range practice.

Friday, Oct. 13th.—Technical for Platoon No. 10, Regency Street. Squad and platoon drill, No. 9. Signalling class. Recruits' drill, 6.25 to 8.25.

Saturday, Oct. 14th.—General parade, 2.45. Uniform, for drill.

Sunday, Oct. 15th.—Entrenching at Otford. Parade Victoria (S.E. & C.Ry.) Booking Office, 8.45 a.m. Uniform, haversacks, water-bottles. Mid-day ration to be carried. Railway vouchers will be provided.

Musketry: For all Companies see Notice and Table A and B at Headquarters.

A "Simplex" Roll of Honour.—The accompanying is a list of "Simplex" men who have done their "bit" for their country:—*Killed*: A. Betts, Worcester Regt. (Brass Shop); H. Bodfish, Warwickshire Regt. (Foundry); J. Ireland, Warwickshire Regt. (Enamelling Shop); E. A. Mousley, R.A.M.C. (Stores Office); G. Parker, Warwickshire Regt. (Fittings Shop); S. Robbins, Worcester Regt. (Fuse Dept.); D. H. Swarsbrick, Warwickshire Regt. (Purchasing Dept.); P. F. Fowkes, Royal Engineers (Manchester Office); W. A. Lock, R.F.A. (General Office); B. Liddiard, Warwickshire Regt. (General Office). *Wounded*: N. Bill, Warwickshire Regt. (Heating Dept.); A. Birtley, Warwickshire Regt. (Purchasing Dept.); C. Boulton, Wilts Regt. (General Office); G. Baird, Scottish Horse (Glasgow Office); J. Cain, Warwickshire Regt. (Foundry); J. Quinney, R.F.A. (Fuse Dept.); F. Raison, Lancs. Fusiliers (Forwarding Dept.); M. Gough, R.G.A. (Foundry); Aldrich, Warwickshire Regt. (Foundry); W. Howell, Middlesex Regt. (Foundry); R. Wooland, Warwickshire Regt. (Forwarding Dept.).

Provisional Order Schemes.—Last session the Board of Trade decided that no applications for Provisional Orders could be lodged except when extreme urgency existed. The Parliamentary Agents' Society, however, has been in communication with the Board on this matter, with the result that it has now been decided to allow applications for Provisional Order schemes to be lodged in the ensuing session where it can be shown that the establishment of works under the schemes proposed will be proceeded with as soon as practicable after the termination of the war. In determining whether an application shall be allowed to proceed, the Board will have particular regard to the considerations as to how far the exercise of powers will provide an outlet for labour or for the utilisation of plant and machinery which have been provided for the purposes of the war. At the same time, it is felt undesirable that proposals should be put forward which are likely to provoke serious opposition or to prove unduly costly to promote.

War Tribunal Cases.—At Accrington Tribunal, on September 29th, the Borough Electrical Engineer applied for five employees at the Electricity Works. Their ages were 25, 39, 25, 41 and 27. —Captain Harwood told the Tribunal that the cases came before the Advisory Committee, but on account of there being three young men under 30 years of age they declined to have anything to do with them. They felt strongly that the Management of the Electricity Works ought to get older men.—The Engineer said there were good grounds for making all the applications. The first one, aged 25, had been in the Territorials, was sent out to Egypt, and was there until last April, when he became time-expired. Older men had been tried but it was found they were physically unfit.—Captain Harwood said perhaps the Tribunal had no option but to give conditional exemption now, but the Engineer would have to face the music when it began to play later on.—Conditional exemption was granted to all the men.

Enemy Firms Wound-up.—Orders have been made by the Board of Trade requiring the under-mentioned firms to be wound up under the Trading with the Enemy (Amendment) Act, 1916:— Selas Co., Ltd., 5, Newcastle Street, Hulme, Manchester, manufacturers of installations for lighting and heating. Controller: John P. Garnett, 61, Brown Street, Manchester; Feld Brothers and Co., Ltd., 432-433, Mansion House Chambers, Queen Victoria Street, London, E.C., manufacturers of electric wires. Controller: J. E. Percival, 6, Old Jewry, E.C.

Chief Technical Assistants Association.—The next meeting of this Association takes place at the Tavistock Hotel, Covent Garden, on Saturday, the 7th inst., at 3 p.m., when a discussion on the Advantages and Disadvantages of Steam and Electrically-Driven Auxiliaries will be opened by Mr. H. F. J. Thompson, of Battersea.

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

AUTOMATIC OPERATION OF MINE HOISTS

THE operating conditions under which automatic control or hand control produces the best results for mine hoists were discussed at the Arizona meeting of the American Institute of Mining Engineers last month. The subject was introduced in a paper by Messrs. H. Kenyon Burch and M. A. Whiting, who described an automatic hoist installation at the Inspiration Consolidated Copper Company's mines. The varying extent to which installations may be automatic is first touched upon in the paper; in a large number of cases certain features of the control are automatic—for example, the rate of acceleration may be limited automatically or the equipment may be stopped automatically at the limit of travel—but the equipment is started and ordinarily is stopped by hand. In other cases the motion of the machinery is utilised to start, control the speed, and stop the motor automatically, independently of any operator. A considerable proportion of the large mine hoists now in use have certain automatic features, particularly protective devices, against overwinding, and in some classes of electric hoists, devices for preventing excessive acceleration and retardation. The large automatic hoists described by the authors, however, are completely automatic, *i.e.*, capable of making their trips without the presence of an operator at the control levers.

Various advantages may be obtained by automatic control, chief of which are decreased power consumption, increased precision and safety of operation, and decreased cost of attendance. The first step in the analysis of a prospective automatic mine hoist is to determine whether automatic operation is feasible at all. If men are to be hoisted, or levels changed, the attention of an operator is required for these purposes; but under some conditions it may be entirely practicable and advantageous to build the equipment so that, while provision is made for hoisting men or changing levels, one can be hoisted automatically from any one level. If, however, an operator's attention is required every few minutes for changing levels, handling men or drills, or for other work requiring hand control, it is obvious that automatic operation between times will not be of any practical benefit.

For a very slow hoisting speed it may be possible for the skip or cage to pass through the dump at full speed, and a sufficiently accurate stop may possibly be obtained automatically by cutting off power and applying the brakes at full speed. In this case, either a shunt wound d.c. motor or an induction motor may be used. A number of slow speed automatic hoists are arranged in this manner, and are driven by induction motors. One equipment of this type used in mining work is an inclined hoist for handling concentrates at one of the mills of the Arizona Copper Company. This hoist has a rope speed of approximately 275 ft. per minute.

For higher rope speeds, at least for speeds over 400 ft. per minute, it is necessary to consider carefully the speed characteristics obtainable from the type of drive proposed. For these higher rope speeds, it is necessary to slow down before entering the dumping horns. Furthermore, the speed about midway in the dump must usually be reduced below the maximum safe speed entering the dump. A reasonably accurate stop is always required; in some cases a total variation of 2 or 3 ft. might not prove prohibitive, but in other cases the stop must be more accurate. For reliable operation, it is nearly always imperative that the automatic-control system shall act in like manner irrespective of load, *i.e.*, that the rate of retardation and the position of stopping be nearly the same whether the skip comes up loaded or empty.

There is only one class of motive power which is inherently suited for automatic operation at high rope speeds, *viz.*, the direct current shunt-wound motor with voltage control. The speed-torque characteristics for an equipment of this character are represented in Fig. 1. These curves are typical of this class of equipment, although the exact slope of the curves will vary slightly in individual cases. Curve 1 shows the characteristics on the lowest, and curve 5 the characteristic on the highest, speed position of the controller for the case selected. The intermediate curves represent three controller points arbitrarily selected out of a total of 30 or more. It will be observed that these curves are nearly, but not quite, parallel. That is to say, the increase in speed in passing from full load to no load is approximately, but not exactly, the same for the various positions of the controller. The deviation from parallelism is due to the effect of armature reactions in the generator and hoist motor, and may be somewhat different for different cases; but its effect is negligible.

The net advantages (for the purpose of automatic hoisting) obtained by this system of drive are as follow:

As the hoist controller is moved back toward the off position the hoist is retarded. In case the net rope pull is sufficient and the stored energy of the moving system is not too great, the hoist motor simply drops back in speed to correspond to the reduced generator voltage obtained on the intermediate position of the controller. If, however, the net rope pull is

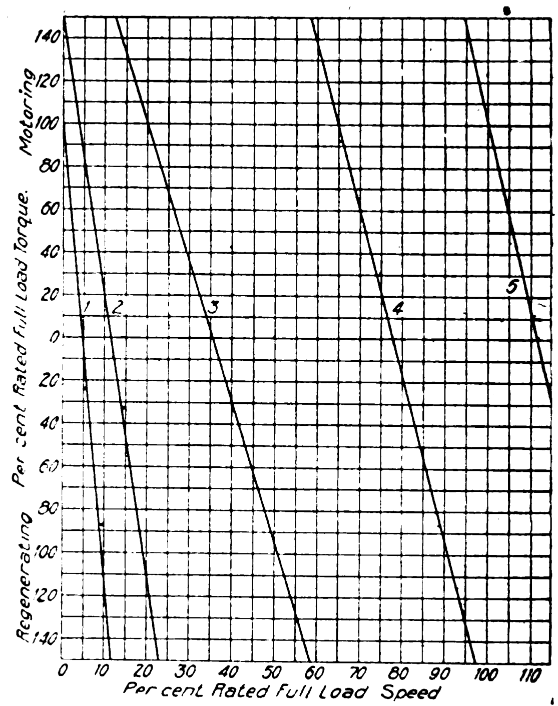


Fig. 1.—Typical Speed-Torque Curves for D.C. Mine Hoist with Generator Field Control.

very low (particularly with empty skips in balance), and if the stored energy of the moving system is high, the hoist motor will invert, momentarily, and will act as a generator, returning power to the motor-generator set. This effect is represented in Fig. 1 by the extension of the curves below zero torque. In this manner, if the controller is moved toward the off position more rapidly than the hoist tends to come to rest under the influence of the load, the hoist motor forcibly retards the hoist. If the controller is moved back at the same rate in both cases, the hoist will be retarded to nearly the same speed, and in nearly the same time, irrespective of load in the skip.

It is fairly obvious that the steam hoist is unable to approach very closely the speed conditions just described. The steam hoist, of course, is capable of retarding a load by working against the steam or compression, but the vital points in relation to automatic hoisting are: (1) for the same throttle opening and cut-off, the speed will vary widely with variation in load; and (2) if the throttle is partly closed or the cut-off advanced to a point at which the skip will enter the dump at a suitable reduced speed, the engine will exert only a slight retarding torque (if any) to help retard from full speed to the reduced speed at which the engine tends to continue. Most

of the retardation must therefore come from the load which is variable, or may even be negative. Furthermore, with a partly closed throttle the final speed at which the engine tends to continue will vary widely with variation in load.

The induction-motor hoist, in its relation to automatic hoisting, has somewhat the same characteristics as the steam hoist. Fig. 2 represents the speed-torque characteristics of a typical mine-hoist induction motor. In a direct-current hoist, a given retardation can be accomplished in a certain time and distance by the same manipulation of the control, irrespective of the load hoisted. In a steam or air hoist or an induction motor hoist, a like retardation of different loads requires different manipulation of the control. These characteristics indicate, and their further consideration confirms, the conclusion that high-speed mine hoists which are to be operated automatically must be, in almost all cases, driven by direct current.

The authors then proceed to a description, which is reproduced in the *General Electric Review*, of the automatic mine hoists at the Inspiration Consolidated Copper Co.'s mines. When the details of the design of this plant were first con-

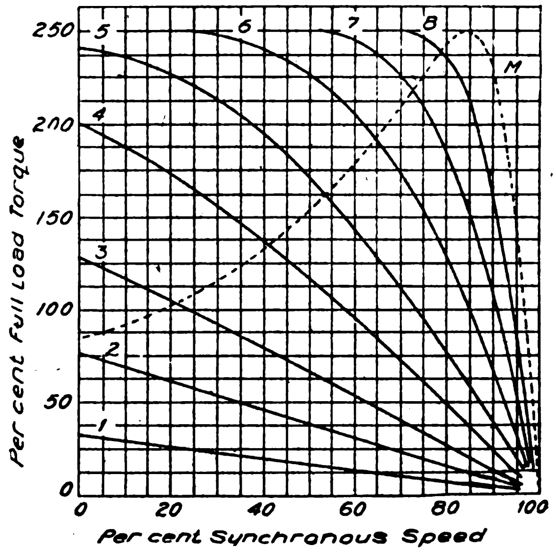


Fig. 2.—Typical Speed-Torque Curves for Induction Motor-driven Mine Hoist.

sidered, one of the chief problems was the arrangement of the control so that the transition from hand to automatic operation, and more especially the transition from automatic to hand operation, might be made without risk or delay, and in a manner easily remembered by any operator acquainted with the equipment. To this end the levers on the operating platform which operate the hoist controllers and brakes for hand control are not disconnected from the controllers or brake engines when running automatically. Consequently, when the automatic pilot devices are cut in, and the hoists are operating automatically, these levers move back and forth, as if the hoists were being controlled by hand by invisible operators. When, therefore, the transition from automatic to hand operation is made during a trip, the brake and controller levers of both hoists are in the correct positions and properly in engagement for hand control.

The automatic operation can be interrupted at any time during a trip. This is done most easily by throwing the master controller for automatic operation to the off position, which causes any trip which is under way at the time to be completed automatically, dumping in the usual manner, but prevents the next trip from starting. If the hoists are then left standing, and not operated by hand, all that is necessary to start automatic hoisting again is to throw the master controller to the automatic running position.

L.C.C. Trade Scholarships.—The London County Council is offering about 250 trade scholarships for the 1916-17 session to boys between the ages of 12½ and 16 years. The scholarships provide free education with maintenance grants ranging from £6 to £15 a year for one, two, or in certain cases, three years at approved trade schools. These include various engineering and allied trades. Application forms (T.2/258) and full particulars may be obtained from the Education Officer (T.2), L.C.C. Education Offices, Victoria Embankment, W.C., not later than October 14th.

Association of Engineers-in-Charge.—Mr. Frank Bailey will deliver his Presidential Address on Wednesday, the 11th inst., at St. Bride's Institute, Bride Lane, Fleet Street, E.C., at 8 p.m.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Principles of Electrical Design: D.C. and A.C. Generators. By A. Still. 365 pp. 9½ in. by 6¼ in. 146 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 12s. 6d. net.

In text-books on design to-day one seldom finds, or expects to find, any new developments expounded, and the result is a certain similarity amongst new books on this subject which makes it difficult to choose between them. In judging the value of a treatise of this nature one has to consider first the extent to which the theoretical treatment of each section is scientifically sound and up to date, so that the student may obtain the utmost value from the limited time he has to spend on such books; and, secondly, the extent to which the practical treatment—the various considerations which guide the designer in the final choice of one of several alternatives—is really representative of modern practice, so that the practical designer in search of information may not get hold of out of date and superseded methods of working. Judged by these standards, Professor Still's book appears to be one which we can recommend to both students and designers. It has the additional advantages of being excellently written and of giving a particularly clear and logical treatment of the subject. The ground covered includes that of the design of D.C. generators and alternators, with preliminary chapters on the design of electromagnets. The author gives reasons for using his own symbols in certain cases; but we are not convinced by them, and would prefer to have seen the more conventional symbols adhered to throughout the book.

Lectures on Telephony.—A public lecture on "Long-distance Telegraphy and Telephony" will be delivered at University College, London, by Dr. J. A. Fleming, F.R.S., on Wednesday, October 18th, at 5.30 p.m. A course of six lectures on "Long-distance Telephony," also by Dr. Fleming, will be given on Fridays at 5 p.m., beginning October 27th. The public lecture is free, but the fee for the course of six lectures is £1 11s. 6d.

THE METROPOLITAN ELECTRIC SUPPLY CO.

Re-constitution Scheme Sanctioned

THE scheme for reconstituting the Board of the Metropolitan Electric Supply Co., outlined on page 353 of our issue for September 14th, was adopted after considerable discussion at an Extraordinary General Meeting on Friday.

Mr. W. H. Cripps, who presided, after expressing regret at the death of Lord John Hay, who has been a director of the company since its formation about twenty-five years ago, said that the object of the meeting was to confirm the scheme prepared by the Shareholders' Committee. Compromises, he said, proverbially satisfied nobody, and it was useless to pretend that he was entirely satisfied with the arrangement come to between the Shareholders' Committee and the Board. Personally, he would have liked all the questions at issue to have been thoroughly threshed out in order that every shareholder would be in a position to form a judgment of his own on the merits. He agreed, however, that the publicity necessarily incident to such a process would be adverse to the true interests of the company, and having satisfied himself that an arrangement was possible on the basis of the resignation by himself of the chairmanship of the company, he had decided not to allow his own wishes or interests to stand in the way. In resigning the office which he had held for seventeen years he would like to have reviewed the work that had been done and to give his reasons for believing in the existing and future prosperity of the company. Circumstances, however, prevented this, as he would, of necessity, have to revive controversies which it was the chief object the compromise to set at rest. At the same time every word that he said on the occasion of the previous meeting of the company in March he adhered to. Much of it had since been confirmed by Sir John Snell and Mr. Pixley, and he regretted that the Shareholders' Committee, in their report, had not further explained the fall in dividend since 1905. The implication was that it was the result of bad management on the part of the Board, and it was this statement that had so thoroughly alarmed the shareholders The fact was that the earnings of the company had not fallen. They had increased. The actual gross receipts in 1906, the year after the sale of nearly half the company's property to the Marylebone Borough Council, were £175,000, but in July, 1916, they had risen to £258,000, or over 44 per cent. The fall in dividend in 1906, due to the sale of the Marylebone undertaking, was amply compensated for out of the excellent award of £1,212,000, which included no less than £660,000 as compensation for loss of future dividends. That sum was returned to the shareholders, who received, approximately, a bonus of £6 10s. for each £10 share held. Moreover, a cordial vote of thanks to the Board had been carried in connection with the success of the Marylebone arbitration. He was sorry the shareholders had not seen Mr. Pixley's report on this vital matter, which entirely supported the explanation he had given at the last meeting. With regard to Mr. Highfield's services as engineer, the Shareholders' Committee asked that he should be retained. In doing so he feared that they could not have accurately followed the facts. The old Board was so fully confident of the value of Mr. Highfield as an engineer that they had already retained his services for a period of five years from the commencement of 1916. He contended that in agreeing to the Shareholders' Committee's scheme he was abandoning no commercial principle to which he had hitherto attached himself. The compromise decided nothing as to policy or principle. It merely effected a change in *personnel* in the Board of Directors. Anyhow, the new chairman and directors were assured of the cordial co-operation of the remaining members of the old board, and, for himself, he would do in the future as he had done in the past, everything in his power to advance the interests of the company in whose future he himself firmly believed.

The proposal that the Committee's report should be adopted was made by Mr. Roger Gregory, the chairman of that Committee. The shareholders, he said, would be glad to hear that in the opinion of the Committee there aws no need for anxiety about the prospects of the company.

There was considerable discussion, some shareholders expressing disappointment at the result of the Committee's labours. Complaint was made that without being given a vestige of information the shareholders were asked to take the compromise on trust, and although their money had been spent on four expert reports, access to them was not given nor was the slightest guidance offered to enable shareholders to arrive at a conclusion. An amendment to refer the report back to the Committee for the purpose of amplification and an adjournment of the annual meeting until November 9th for the submission of a further report was put to the meeting but negatived after a number of shareholders had taken part in the discussion.

ELECTRICITY SUPPLY AT BETHNAL GREEN

THE Borough of Bethnal Green was for long the only portion of London without any system of electrical supply. The Borough Council obtained a Provisional Order as far back as 1899, and a scheme for supply from a combined generating station and dust destructor was prepared by the late Mr. Robert Hammond, but for various reasons the plan did not materialise. The matter was taken up again in 1912, when Sir John Snell reported on the situation and recommended that a supply in bulk be taken from one of the neighbouring boroughs, all of which have important electricity undertakings, or from a supply company. Tenders for bulk supply were accordingly invited, and were received from the electricity departments of Shoreditch, Stepney and Poplar, as well as from the County of London Electric Supply Co. and the Charing Cross, West End and City Electricity Supply Co. The tender of the Stepney Borough Council being the most favourable was finally accepted on the advice of Sir John Snell and a contract was entered into, followed by a further agreement under which the Stepney Council are to manage the undertaking for the first four years.

The supply is from the Blyths Wharf generating station at Limehouse of the Stepney Borough Council, which was described in its original form in ELECTRICAL ENGINEERING, October 28th, 1909, page 931. Further extensions to the plant, making it one of the most up-to-date power houses in the Metropolitan area, were described in a further article on page 425 of our issue of October 21st, 1915. The supply is given at 5,850 volts three-phase, 50 cycles, through duplicate trunk mains laid up to their own boundary by the Stepney authorities and inside the area of the Bethnal Green Council. These cables—which, together with the whole of the distributing cable, were supplied by British Insulated and Helsley Cables, Ltd.—are looped in to two transformer sub-stations at New Tyssen Street and Digby Street. Each of these sub-stations is equipped at present with one 500 k.v.a. and one 250 k.v.a. three-phase oil-cooled transformer, but space is provided for considerable extensions. These transformers, together with the whole of the high and low tension switch gear, were supplied by the British Westinghouse Co., and the whole equipment is of their standard pattern. The H.T. switch gear is all enclosed in cells under the operating gallery, and an interconnecting panel is provided in the centre of the board, arranged so that the sub-station can be fed by the incoming feeders from either or both directions, recalling the advantage of a ring main. Merz-Price protective gear is fitted throughout. The L.T. board is, of course, quite separate, and does not present any very special features.

The distributing network is on the four-wire three-phase system, with 240 volts between phase and earth and 415 volts between phases, and the cables are all lead-covered and laid solid in troughing. The only part where cables are laid along both sides of the street is in the Bethnal Green Road, and it may be mentioned that the whole distributing network, which feeds an area somewhat over one square mile, did not exceed £25,500 in capital cost. The district is one including a fair number of factories relating to the wood-working, leather-working, and army clothing trades, and a portion of the power load near the boundary has been supplied by the Shoreditch Council and to a less extent by the Stepney undertaking, but eventually the whole of this will be transferred to the new Bethnal Green system. The scheme not only starts up with a comparatively small connected load, but in addition to the transferred load just mentioned a rapidly increasing power load is looked forward to. Small power users had lately avoided settling in the district, owing to cheap electric power facilities available elsewhere. There is at present no electric street lighting. Although the scheme was decided upon well before the war, most of the work was done since the war began, and Treasury sanction had to be obtained for it to be put in hand.

The New Tyssen Street and Digby Street sub-stations will be formally opened by the Mayor of Bethnal Green, Councillor W. J. Lewis, J.P., this afternoon, when a number of friends will be entertained by Councillor Cole, chairman of the Electricity Committee. It should be added that the sub-station buildings were designed and erected under the superintendence of the Borough Engineer, Mr. A. E. Darby, and that the whole scheme was carried out under the superintendence of Messrs. Couzens and Brown, consulting engineers. We wish in conclusion to express our thanks to Mr. H. W. Couzens for information regarding the undertaking upon which this article is based.

OVERHEAD TRANSMISSION LINE WAYLEAVES

The Case for Legislation

As the question of wayleaves for overhead transmission lines will play an important part in any comprehensive scheme of electric power distribution throughout the United Kingdom, it is not too early for preliminary steps, at any rate, to be taken to deal with the difficulties which have for so long stood in the way of a more rapid extension of this form of power distribution. Electric power supply on what might be termed universal lines being a matter of national importance, it is clear that the nation must come before the individual, and the artificial obstacles now introduced by the veto possessed either by public bodies or private individuals, must be swept away. It is notorious that such artificial obstacles exist to-day in a very marked degree, and as recourse must eventually be had to legislation, the first thing to be considered and secured is the unity of the electric supply industry as a whole upon the principle involved. Although, unfortunately, even in the electric supply industry there are conflicting interests, we hardly anticipate that in this matter they can be of such a nature as to preclude the possibility of agreement upon the nature of the application to be made to Parliament to secure the object in view. There cannot be a central station engineer who would argue against the principle of compulsory wayleaves, with reasonable regard to the rights of owners. If there be such, another field of activity should claim him at the earliest possible moment.

The matter has assumed some immediate importance by the work that is being carried on by the Fuel Committee of the British Association, and the Conferences which are being held between the Incorporated Municipal Electrical Association and the Association of Electric Power Companies.

Special attention may be drawn to Mr. W. A. Chamen's remarks in the discussion on the B.A. Fuel Economy Committee's report at the Newcastle meeting this year (Electrical Engineering, September 14th, p. 351), and it is common knowledge that many a contemplated supply of electricity has had to be abandoned owing to the impossibility of agreeing to the wayleave terms imposed or the exercise unreasonably of the absolute veto conferred by the law of the land as it exists to-day upon landowners and local authorities. Whilst at the present moment it is out of the question to hope to secure the passage of any legislation, nevertheless it does form one of the post-war problems which we should prepare now to deal with, so that when the opportunity occurs it may be taken in hand as part of the comprehensive scheme of fuel economy and power distribution. Unless this is done valuable time will be lost, for, notwithstanding that in itself the whole thing seems a comparatively small matter, yet it must be borne in mind that those in possession of the much-cherished "rights" referred to will bring all their available strength to fight the industry. Therefore, now is the time for all sections of the industry to do their utmost to assist in framing an amendment to the existing legislation—that seems the simplest way—in order to secure, on terms of course, a clause which would grant compulsory wayleaves to statutory undertakings.

Whilst urging immediate and energetic action it must not be supposed that we are suggesting that obstruction is general throughout the country. Such a contention could hardly hold good having regard to the undoubtedly large mileage of overhead transmission lines in various parts of the country, and particularly in the areas of the power companies. Nevertheless difficulties of such a serious character are still met with as to warrant a firm line of action being taken. Each instance in which a supply has had to be abandoned, and we mention a few below, means not merely the loss of sale of so many units per annum—that in itself in the aggregate may amount to thousands of pounds alone—but it also means a loss to the manufacturers of electrical plant and machinery, and it may also mean a loss to a particular locality or even to the country, of a new industry, where the conditions are such that the cost of laying underground mains by circuitous routes is prohibitive. Looked at in this way, it will the better be perceived to what extent this is a national problem, and as such should receive the full support of the whole electrical industry.

Incidentally, it may be recalled that under the Telegraph (Construction) Act, 1916, the Postmaster-General suffering under the disabilities outlined above found no difficulty in securing compulsory powers for wayleaves on private property, it being provided that the terms should be settled by a stipendiary magistrate or a County Court judge. Experience, perhaps, rather suggests that neither of these is the ideal body to settle a matter of this kind, and there is a good deal to be said for the suggestion that if a tribunal were constituted on the lines of the Railway and Canal Commissioners it would be preferable.

Before quoting some specific instances of difficulties which have been encountered, it may be pointed out generally that as things stand at present a statutory company is not allowed to erect overhead wires on private property other than its own land without the consent of the local authority. This, of course, applies particularly to roads. The difficulties with landowners arise from their request for excessive payments or their refusal to grant a wayleave for a reasonable period. In some cases the prices asked are prohibitive, and underground cables have to be adopted or the supply abandoned. In other cases such periods of tenure as six months have been suggested for wayleaves for lines supplying users with whom the electric supply authority has an agreement for ten years. This position of affairs is obviously quite impossible.

A few instances of wayleave difficulties are enumerated :—

A firm order was in hand for a fairly large colliery supply situate some two miles from the nearest E.H.T. mains. The intervening proprietors were approached for an overhead wayleave, but the colliery not being on their particular estate, they declined to give facilities, and the route by road being a circuitous one, the capital outlay necessary to lay underground mains made the business quite prohibitive. As a matter of fact, this colliery is not being supplied yet, though the order was in hand four years ago. This is a clear case where fuel economy has been sacrificed to estate amenity.

A large munition works urgently required a supply. The supply necessitated underground mains for a distance of several miles. A considerable distance of this route could have been saved by running the underground cable along the banks of a river. The owners of the river frontage declined to allow the cables to be run underground or overhead, even though the work was of national importance, so that ultimately a long, circuitous route had to be taken, causing a considerable amount of extra labour and extra cost to the nation at a time when both items should be husbanded to the utmost.

The electric supply authority had been approached by a district in which there were a large number of works for a supply necessitating some eight miles of line. To have put this underground all the way would have meant a very high outlay, and the certainty of the line showing a loss for a considerable period. Two large estate proprietors on the route were approached for a wayleave for carrying an overhead line which would have saved several miles of track. After endless back and forward negotiation, the wayleave was finally declined.

An interconnector was being arranged between two important centres to secure reliability of supply to a number of works working night and day on Government work. After some considerable difficulty, a portion of the wayleave was arranged through one estate, but the proprietor of the neighbouring estate went out of his way to insist, in granting his portion, that the former estate should alter their line of route, so that the overhead line could not be seen from one point on the latter's estate about a mile away. This deviation caused the greatest trouble and expense.

A power company has always considerable difficulty in arranging wayleaves with public bodies. In a recent case, involving a very small portion of an important line, they were met with a point blank refusal for overhead or underground work, for no specific reason, necessitating considerable deviation.

An interconnecting wayleave had to be negotiated with the view of securing reliability of supply to munition works, and generally to a large portion of an important power company's area. For months the Company endeavoured to negotiate routes with sundry proprietors on the way, but were unable to make any headway at all, and finally had to take a large portion by roadway, which added to the cost materially, and indirectly affects cost of supply.

An order was in hand for a small colliery supply on a line

of route which offered considerable advantage from a general reliability point of view of the whole distribution system. The estate interested refused permission to carry out the work, and after months of negotiation, finally put forward such onerous conditions that the work was suspended indefinitely. The colliery is still operating its uneconomical small private plant.

An important colliery company desired supply for one of their collieries. The public road approached within a few hundred yards of the colliery, but the intervening proprietor refuses absolutely to allow mains to be laid—even underground—through his property. To give the supply will necessitate another and much longer route.

In a recent case involving some five miles of overhead line, everything had been satisfactorily arranged but one estate, a breadth of some 300 yards, on the route. This was absolutely refused, and with the utmost difficulty the whole route had to be rearranged to work round the estate in question.

A noteworthy case is that of negotiations with one of the largest landowners and one of the wealthiest commoners in a leading industrial district of England. These commenced in 1911, and were never completed because of the terms asked for, and at the present time the supply authority, again a power company, has been unable to complete an important loop in a mining district because it cannot obtain reasonable wayleave facilities. The landowner in question made no secret of his desire that he would prefer the company to keep to the public roads and use underground cables, but as this could not be done he set down the conditions on which he would grant a wayleave for poles. He stipulated that they should be as far as possible fixed close to fences, and objected to one route crossing a meadow and arable fields. The rent was to be 5s. per single pole per year for the first three years, afterwards to be increased to 10s. per single pole per year. At the expiration of three years the company might be required to supply, by underground cable, current for power and lighting purposes to certain property on the estate, also the company might be required to provide and maintain pole lines to other buildings on the estate or buildings yet to be erected, a satisfactory continuous supply of current to be given in all cases free of charge. The poles were to be removed if any land was required for mining or building purposes. One or two modifications were suggested by the company, but the owner practically refused to concede anything over these demands, notwithstanding that the power company agreed to the rentals with the stipulation that there should be no rent charged for poles supplying premises on the estate, and with the stipulation that there should be a limitation of the buildings to which a free supply was to be given. A number of interviews followed, and further alternative proposals were made by the company, but again without success, and, as mentioned, it has not been possible to do anything further in the matter.

ELECTRIC TRACTION NOTES

A demonstration was given on Wednesday of last week of an interesting machine for the removal of corrugations on tramway rails on the Bexley Heath tramway system, where the Woods Gilbert Rail Planer Co. (2 and 3, Norfolk Street, Strand) are carrying out a contract for dressing joints and removing corrugations. The machine is self-contained and electrically driven, and the work that it performs consists of deepening the groove and removing high checks by means of a milling cutter and dressing joints and getting rid of corrugations by grinding. A number of prominent tramway men were present and expressed appreciation of the process. The work in progress at Bexley Heath, however, consists entirely of grinding, and the milling head was not seen in use at the demonstration. We understand that the work in this district will be completed in two or three weeks' time, after which the machine is to be moved to Bolton to commence an extensive contract. The machine, we believe, originated in Australia, and the company's first contract in this country was on the Oldham, Ashton and Hyde Tramways, and although the work has been completed for nearly four years there are as yet no signs of corrugations recurring. Similar work has also been carried out at Thanet, Cardiff and Wigan. An important feature of the machine is the way it is fitted with transverse wheels and lifting gear to enable it to traverse clear of the track, although its weight is about 10 tons, to allow cars to pass. The machine is self-propelling and is both propelled and worked by a 50-h.p. shunt motor. The two 24-in. grinding wheels are mounted on a separate trolley lowered on to the track by levers from the main trolley, and each has its separate friction-driven vertical feed gear. There are a number of ingenious points in the arrangements of the gearing.

Sir Alexander Kennedy, who is named in the Edinburgh Tramway Company's lease as arbitrator to deal with matters of dispute between the company and the corporation, has been asked to act. The main point of difference is that the company has refused, although called upon by the corporation, to put into good condition a large mileage of track. When this point is cleared out of the way it is hoped to progress further with the negotiations for the corporation to take over the tramway undertaking before the expiry of the lease three years hence.

The new electrically operated line of the London and South-Western Railway Co., between Waterloo and Claygate, on the Guildford section, was opened for traffic on Monday.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

REPLIES TO No. 1,511.

A Canadian hydro-electric power plant includes six alternators with a total capacity of 7,000 kw. The load is highly inductive, and therefore operated at a very poor power factor. State the best method of improving the power factor, considering cost, reliability, space factor, etc. Would it be preferable to fit a machine to each unit, or operate one machine on common bus-bars, all the alternators being in parallel?—W. E. L.

The first award (10s.) is made to "Control" for the following reply:—

From the information given, it is impossible to make anything beyond a general statement; the question might have been made more interesting by giving some idea of the situation of load relative to generating station, the feeder system, and the largest size of motors on load. W. E. L.'s trouble is apparently that the running plant, not including standby plant, of the hydro-electric stations, although operating at full K.V.A. capacity, is not at full kw. capacity, any additional load in the future necessitating extensions, unless the power-factor of existing load can be improved, and this can be done by either of the following methods: (*a*) installing synchronous motors, (*b*) installing phase advancers or Kapp's vibrator, (*c*) installing static condensers, (*d*) standby plant at station being run as synchronous motors. No mention is made of direct current being required in any way, so it is presumed the alternative of rotary converters is out of the question. If at all possible, the poor power-factor should be corrected at its source—that is, where the load is, usually induction motors, or at sub-stations, if any; this would then relieve the load on mains up to the point at which correcting device is installed, and reduce the losses in distribution system, tending further to improve the voltage regulation.

Dealing with above methods: (*a*) This appears to be the method W. E. L. has in view; it would certainly not be advisable to have a separate machine for each generating unit, the price per k.v.a. for small units being much higher than for large units, and the total floor space occupied greater. If the correcting device must be installed at the generating station, then have, say, one or two machines operating on the common bus-bars. Each of the existing alternators has an average output of 1,165 kw., and, assuming the machines were designed for a power factor of 0·85, the k.v.a. would be 1,370. If present load has power factor of 0·7, and the load is taken by four of the six alternators, total load is 5,500 k.v.a. approximately, and the

wattless component to be supplied by the synchronous motors in order to bring power factor back to 0·85 would be 1,500 k.v.a. Allowing for losses, two synchronous motors, each of 800 k.v.a. capacity to supply wattless current only, would be required, and the present-day price for these of the self-starting type complete with switchgear runs out about £2 per k.v.a.—a fairly costly arrangement. The synchronous motors could, instead of being run light supplying wattless current to the line or generators, be made to do a certain amount of useful work; this is a better-paying proposition, as it brings down considerably the price of plant allocated to power-factor correction. In the generating station or sub-stations there would not be much scope for this; clients, however, might be invited to instal synchronous motors on their premises by offering them reduced rates for the supply of power.

(b) Both phase advancers and Kapp vibrator are limited commercially for use with large induction motors of wound rotor type not less than about 150 h.p. These machines supply the wattless component of motor to the rotor at the frequency of slip, and can be made to operate the motor at unity or leading power factor, thus compensating for poor power factor of other motors in the vicinity. They have the advantage that they must be fitted at the source of the poor power factor, cost very little for upkeep, and are reliable. Here, again, reduced power rates could be offered to clients installing such apparatus in conjunction with their existing motors.

(c) Static condensers have the advantage that they can be conveniently inserted in circuit at the motor either squirrel-cage or wound rotor type, and cost very little for upkeep. Condensers are at present being made for this class of work, but none of the existing installations on a large scale have been operating for a sufficient period to prove their complete reliability.

(d) This is a modification of the synchronous motor method; one of the standby sets at the station could be run up to speed by the water turbine, paralleled, the excitation gradually increased, and the water shut off the turbine, so that the alternator floats on the mains running as a synchronous motor supplying a wattless current. In this particular case, unless the other four machines were not fully loaded and the running of additional machine, as motor, enabled one of the sets to be shut down, the benefit is not apparent, beyond improving the P.F. of the loaded machines. On any future extensions of load the installation of polyphase commutator motors might be worth considering; these may be run at unity power factor, and in some cases even take leading current from the line.

The second award (5s.) is made to "E. H.," who writes as follows:—

The power factor of any system can be improved by means of one or more of the following: (a) over-excited rotary converters, not employed unless d.c. is required; (b) over-excited synchronous motors; (c) rotary condensers; (d) static condensers; and (e) phase advancers in conjunction with induction motors.

Synchronous motors are generally only suitable for starting up on light load, and are more expensive than induction motors of the same power. Consequently, a consumer cannot be expected to instal such machines unless he is compensated by the supply company in some way or another.

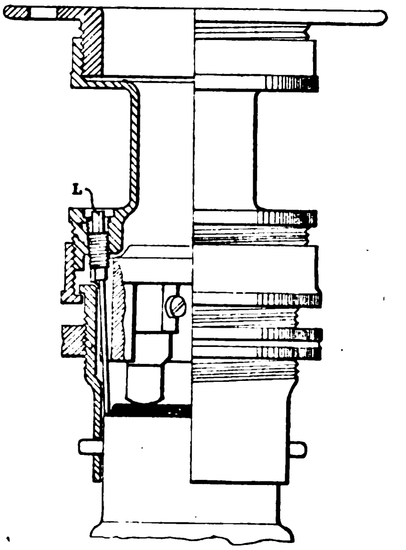
Rotary condensers are really over-excited synchronous motors running light—*i.e.*, unconnected to any load. Such machines can be installed either in the generating station or in a sub-station; in the latter case the cost of operation is increased, since sub-station attendants are then necessary. It must be remembered, however, that a low-power factor, in addition to diminishing the kilowatt capacity and adversely affecting the regulation of the alternators, also decreases the kilowatt-carrying capacity of the mains. Now if the apparatus or machines for improving the p.f. be installed at the generating station, the improvement affects the alternators only, the current in the mains (and its lag behind the voltage) remaining unaltered. On the other hand, if the condensers be at the far end of the line, the improvement in p.f. applies to the mains as well as to the generators. In the case of a long overhead transmission line possessing a large inductance, or where a number of induction motors (which are the worst offenders in lowering the p.f.) are grouped together some distance from the generating station, the increased operating costs of a rotary-condenser sub-station are generally more than counterbalanced by the smaller capital cost of the mains. This is confirmed by a study of modern American practice. Condensers of the static type, owing to their high cost and the relatively large space required, are only suitable for correcting the p.f. of small induction motors.

Most of the lag in an A.C. system is caused by the magnetising currents taken by induction motors. By the use of phase advancers, however, these currents can be supplied to the rotor windings, so that the stator and the supply mains are relieved of the lagging currents; in fact, a phase advancer can even be arranged to make the stator winding take a leading current, and thus neutralise more or less the magnetising currents taken by other induction motors not fitted with phase advancers. It will be evident that this method corrects the p.f. at the ideal place; but naturally a consumer—who generally pays for kilowatts and not kilovolt-amperes—will not instal these auxiliary machines unless he is given some inducement by the supply company. The cost of phase advancers, however, becomes relatively large in the case of small motors, so that it only becomes economical to instal them for machines of about 100 B.H.P. and upwards.

From the above, it will be seen that the choice generally lies between the over-excited synchronous motor, the rotary condenser, and the phase advancer, and their relative suitability for a given case depends entirely upon the conditions obtaining, such as the distribution of the inductive load, the size of the induction motors, the space available at the generating and at the sub-stations, &c. On the question of reliability there is practically no difference between the three methods, while as regards their cost the writer is not acquainted with Canadian prices, but in this country, about two years ago, the costs of the synchronous motor, the rotary condenser, and the phase advancer were roughly about £1 5s., £2, and 10s. respectively per leading kilovolt-ampere. If the installation for improving the p.f. is to be at the generating station, then it is far more economical to operate one machine on common bus-bars with all the alternators in parallel, than to fit a machine to each unit.—E. H.

A LOCKING LAMPHOLDER

An improved design of locking lampholder from which lamps when once locked can only be removed by using a special key has been introduced by Mr. C. H. Jeffcoat (10, Ranelagh Gardens, Hammersmith, W.), acting on the same principle as the locking lamp holder described and illustrated in Electric Engineering, Feb. 11th, 1915, p. 62. One form made up as pattern holder is shown in part section in the illustration. It will be seen that a locking pin L screwed near the top and with a triangular head passes through the lampholder base, and when screwed home bears against the collar of the lamp cap just inside the lampholder body, preventing the lamp from being pushed in to disengage the bayonet socket. When the lamp is to be removed the pin is slacked back a little by means of a special key which takes the form of a miniature right-angled box spanner with a six-rayed star-shaped interior fitting in a number of positions over the triangular head of the locking pin. It should be noted that the head of the pin is invisible from below, and that the presence of a shade in no way interferes with the insertion of the key. This is only one of a number of lamp-locking devices which Mr. Jeffcoat has introduced, and in many situations should be found of great utility.



Jeffcoat Locking Lampholder.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"Hill's Polish-English and English-Polish Vest-Pocket Dictionary with Conversations and Idioms." By F. B. Czarnomski. 382 pp. 5½ in. by 2½ in. (London: L. B. Hill.) 1s. net; by post 1s. 2d.

"The Indicator Handbook." By C. N. Pickworth. Part I. The Indicator: Its Construction and Application. 142 pp. 7½ in. by 5 in. 92 figures. (Manchester: Emmott and Co., Ltd.) Fifth edition. 3s. net; abroad 3s. 5d.

[A revised edition of a well-known handbook.]

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published September 28th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

24,629/16. **Constant Voltage Regulation.** Soc. Anon. des Etablissements L. Bleriot. An electrical installation comprising a supply circuit, a supplied circuit, and an auxiliary motor-generator controlled by an electro-magnetic or a thermal regulator, producing an E.M.F. which is variable in direction and strength in such a way that it can be added to or subtracted from that one of the two circuits which has not to be regulated, so that a constant voltage is obtained in the other circuit. The arrangement permits of recuperation of the supplementary energy supplied by the supply circuit when its voltage is greater than that of the supplied circuit. The system is applicable to battery circuits of central battery telephone systems.

12,590/15. **Cinema-theatre Lighting.** J. T. Taylor and M. H. Herd. Lighting of gangways in cinema theatres, &c., by lamps placed in recesses in the floor under translucent covers and with reflectors arranged to throw a strong light upward.

12,644/15. **Testing Set.** F. J. Crozier and W. G. Wheller. A portable set for making fall of potential tests of armature windings, &c., comprising a voltmeter and adjustable resistance, suitable contacts, &c., and an automatic circuit-breaker which opens the circuit if the voltage applied exceeds a certain value and closes it if the voltage is reduced again.

12,781/15. **Vehicle Lighting.** P. Frost-Smith and V. S. Robinson. An independent lighting set for motor vehicles comprising a small, separate internal combustion engine coupled to a dynamo built into the same case, working direct on the lamp circuit without a storage battery.

12,792/15. **Metal Filament Lamps.** British Thomson-Houston Co. (*G.E. Co., U.S.A.*). Lamps for projectors, &c., with coiled filaments in grid form with the parallel sections are spaced apart by distance approximately equal to the diameter of the coils.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: Sperry [Searchlights] 12,999/15; Brokie and Johnson & Phillips, Ltd. [Regulating arc lamps] 13,079/15, and [Projector lamps] 13,080/15.

Distributing Systems, Cables and Wires, Insulating Materials, etc.: J. E. Grocott [Holder for carrying two separate cables] 3,059/16 (101,372).

Dynamos and Motors, and Transformers: Heys (*Neuland Patents, Ltd.*) [Motors] 13,481/15; Thordarson [Transformers] 13,587/15; Allmanna Svenska Elektriska Aktiebolaget [D.C. dynamos] 5,391/16 (*100,394*); M. Breslauer [Unipolar power transmission apparatus] 9,937/16 (*100,894*).

Electrometallurgy and Electrochemistry: Hepburn [Bipolar electrode electrolysers] 12,730/15.

Heating and Cooking: Marks (*Landers, Friary, and Clark*) [Electric heaters] 8,508/15; L. Heller [Heating devices] 4,901/16 (*100,230*).

Incandescent Lamps: Simonotti and Simonotti [Incandescent lamps] 12,798/15.

Switchgear, Fuses, and Fittings: Dey [Controllers] 12,810/15; Igranic Electric Co. (*Cutler-Hammer Mfg. Co.*) [Controllers] 1,246/16 (*101,362*); J. G. Clemens [Refillable fuse plugs] 7,291/16 (*100,538*).

Telephony and Telegraphy: Alexander [Line insulator] 16,550/15; Relay Automatic Telephone Co., F. M. Ward, G. M. Bryant, and T. M. Inman [Automatic telephone systems] 1,821/16 (*101,047*).

Miscellaneous: Simson (*Saldau*) [Apparatus for determining the "critical" point of steel by resistance measurement] 12,993/15; Southgate [Electrical sounding of bells] 13,216/15; Pearce [Lanterns for producing artificial daylight] 14,941/15; Burdon (*Siemens & Halske A.G.*) [Relays] 17,474/15; W. C. Crockatt and Bromell Patents Co. [Electrical testing of feed water] 5,163/16 (*101,387*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Electrometallurgy: I. Rennerfelt [Electric furnace] 12,396/16 (*101,412*).

Telegraphy: A. U. Sarnmark [Means for operating apparatus at a receiving station by wireless] 12,395/16 (*101,411*); L. de Forest [Radio-telephone transmitter systems] 12,505/16 (*101,415*).

Miscellaneous: H. R. van Deventer [Generating and lighting devices] 12,690/16 (*101,422*).

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

21,914/02. **Voltage Regulation.** H. H. Lake (*G.E. Co., U.S.A.*). A voltage regulator for alternators working by automatic intermittent short-circuiting of the exciter field rheostat by means of a system of relays.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: A. J. Boult (*Voight & Haeffner A.G.*) [Photographic arc lamps] 14,128/09.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: H. Edmunds and P. Dawson [Concentric cables] 12,170/05.

Dynamos, Motors, and Transformers: British Thomson-Houston Co. (*G.E. Co., U.S.A.*) [Transformers] 13,278/04.

Switchgear, Fuses, and Fittings: G. O. Donovan [Controllers] 13,590/09.

Miscellaneous: M. Sundheimer [Burglar alarms] 13,956/09.

THE GENERATION OF ELECTRICITY ON A SMALL SCALE OR BULK SUPPLY

The discussion on the paper with the above title, read by Mr. H. S. Ellis at the June meeting of the Incorporated Municipal Electrical Association (see Electrical Engineering, June 22nd, p. 231, and June 29th, p. 242) is concluded by the publication in the Association's annual volume of proceedings of some additional communicated remarks and the author's reply.

Mr. A. H. Shaw (Borough Electrical Engineer, Ilford), referring to a remark in the paper, that "the best way to improve the load factor is to increase the number of industries connected," writes that in many small undertakings in which the possible power load is limited, the only means of obtaining this result is by pushing the heating and cooking business. In his own experience, however, it was impossible to do much in this way unless the necessary apparatus can be let out on hire. Unfortunately, many small stations were planted in unsuitable positions some fifteen to twenty years ago, and in some cases these stations are in adjacent districts only a few miles apart. Where no external bulk supply is available a solution may perhaps be found by the neighbouring authorities appointing a joint board and erecting a bulk supply station in a suitable situation to supply themselves. Such a station would then supply the main load of each of the smaller stations, these being chiefly used as converting and distributing stations and possibly assisting the bulk supply on the peak. By such means the load factor of the bulk station would probably reach 70 to 80 per cent., and the costs of supply would be reduced to a lower figure than it would be possible to attain at some future date by taking a bulk supply from some large company with high transmission costs. Mr. Shaw is of opinion that the Government should prohibit the further extension of small stations where advisable. By this means a considerable saving in coal might be effected.

Mr. Ellis in his reply said that he had tried to show in his paper that stations having a maximum load exceeding 2,000 kw. were probably in a position to produce current as cheaply as they would be able to do if a bulk supply was taken. It is rather a difficult matter to decide what are small stations at the present time compared with such stations as we have heard about recently. There are probably only a dozen power stations in this country that could be considered large stations. Therefore, it would be going rather far for the author to suggest that the whole of the small stations should cease to generate and take their supply from the super stations. Such a state of things is absolutely impracticable at the present time, and is likely to remain so until the various networks

throughout the country have been linked up and a demand created for several super stations capable of an output of from 100,000 to 200,000 kw., or even more.

The idea which seems to have been prevalent recently of immediately building super stations, and then for the engineers of such stations to run about the country finding load, will simply result in these stations being a drain on the resources of whoever is responsible for them, because it will mean that before a station is completed and the whole of the available supply in use the first plant installed will be more or less obsolete.

LOCAL NOTES

Bristol: *Electricity Accounts.*—In bringing the accounts of the Electricity Department for last year before the City Council last week, Mr. Thomas, upon whom the task fell owing to the illness of the chairman, Alderman Pearson, drew special attention to the large increase in the number of units sold—namely, 3,463,812. That, he said, is the largest increase that has occurred in any year. During the course of the discussion complaint was made that although the Committee claimed to have increased the revenue by £16,302, this was due to extra charges made upon existing consumers. Moreover, the expenses had increased by over £5,000 more than the increase of revenue, and it was suggested that there would be a loss on the current year's working unless the existing prices were further increased. The reply to these points was that, although there had been an increase of 3,000,000 in the units sold, the fact that the profit was less than in the previous year was due to the very large increase in the cost of the necessary raw materials. Thus the Committee were faced with the necessity of either charging a full remunerative price or of reducing the profit. The general view of the Committee was that it was better for the city to supply power at as low a rate as possible, and for last year they had adopted the latter view. In addition to an increase of £16,600 in the cost of coal, workmen had been given increased wages to the extent of £1,536, but there had been no preventable increase in running charges. There were also comments upon the Committee's policy with regard to depreciation, but the report and accounts, the main figures of which we give on page 363 of our issue for September 21st, were finally adopted.

Doncaster: *Electricity Deficit.*—There was a deficit of £263 on the working of the electricity undertaking last year, compared with a surplus of £1,295 for the previous twelve months.

Dover: *Estimated Deficit.*—The Borough Electrical Engineer estimates a loss on the year's working of £2,617. Of this, however, no less than £2,316 is accounted for by increased interest and sinking fund charges on the Admiralty loan, which was formerly 4 per cent., but is now 5½ per cent. At a special meeting of the Electricity Committee last week a long discussion took place upon the desirability of increasing the charges to consumers, and eventually it was decided to recommend the Corporation to add ½d. per unit to the tramway, private lighting and power supply as from Oct. 1st.

London: *Kensington: Increased Electricity Charges.*—The Council has agreed to the proposal of the Notting Hill Electric Lighting Company to add a further 10 per cent. to the charge for electricity. This will bring the lighting charge to 6d.

Torquay: *Increased Charges.*—The Council has decided to increase the present charge of 4½d. per unit for private lighting to 5d. per unit. In putting this before the corporation, the chairman of the Electric Lighting Committee last week said that the great increase in the cost of coal is almost the sole reason for this action. It is anticipated that an additional £1,000 per annum will thus be obtained.

Worksop: *Electricity Works Staff.*—When Mr. J. B. Crowther, the corporation's chief electrical engineer, joined the forces some time ago, it was decided to allow him half his salary, the understanding being, it is alleged by some people, that no further help would be required at the electricity works. At the last meeting of the Lighting Committee the appointment of an assistant engineer was recommended and carried by a small majority, but, according to the *Sheffield Telegraph*, the chairman of the Lighting Committee has in consequence of certain insinuations resigned. At the last meeting of the corporation it was strongly put forward that the electricity works is under-staffed and that the appointment of an assistant engineer is more than justified and is not suggested in order to provide a post for a friend. The gentleman responsible assured the corporation that his suggestion that the works are already over-staffed was not intended as a personal attack upon the chairman of the Lighting Committee, who has been asked to withdraw his resignation.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

London: *Hampstead.*—New feeder cable is to be laid at an estimated cost of £2,929.

South Africa.—The Johannesburg Council requires 12 gross of carbon brushes for electric motors. Copies of the specification may be consulted at 73 Basinghall Street, E.C.

Sunderland.—An important scheme of extensions at the Hylton Road power station has been sanctioned, at an estimated cost of £45,246.

Miscellaneous

Mersey Railway Co.—A supply of electrical sundries and metallic and carbon filament lamps and fittings is required. General Manager, October 12th. Patterns and samples will be on view on the 5th and 6th inst., as per form of tender.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £139 to £141 (last week £137 to £139).

Advance in Prices.—The Benjamin Electric Co., Ltd. (1A Rosebery Avenue, London, E.C.) notify further advances in the price of certain of their goods, varying from 20 to 75 per cent. Accompanying the notification are particulars of increased manufacturing costs, which in some cases is as much as 250 per cent. on pre-war prices.

Agencies.—The Sydney office of H.M. Trade Commissioner in Australia reports that a local agent desires to represent United Kingdom manufacturers of electric lamps.

The Wellington branch of an Australian firm of manufacturers' agents desires to represent United Kingdom manufacturers of electrical goods. The names and addresses of both these firms is available at 73, Basinghall Street, E.C. Any applications should quote the reference numbers 314 and 315, respectively.

APPOINTMENTS AND PERSONAL NOTES

Mr. W. L. Slattery, traffic manager to the London County Council Tramways, has been appointed tramway manager at West Ham in succession to Mr. J. S. D. Moffat, who recently secured the Belfast appointment. The short list of candidates consisted of Mr. Slattery and Mr. W. Clough, general manager of the Bury Corporation Tramways.

The salary of Mr. T. S. Shenton, Electrical Engineer to the Rugby Urban District Council, has been increased by £25, making it £250 per annum.

Mr. E. Cecil Beman, managing director of the E.S. Co., Ltd., "The Light House," 233 Tottenham Court Road, W., has acquired the entire interest of Mr. F. J. Roden, who has resigned his position as director.

The Wigan Corporation require a borough electrical engineer at a salary of £400 per annum. Applications to Town Clerk.

A works electrician is required by the Port Elizabeth (S.A.) Municipal Electricity Department. Applications to Messrs. Davis and Soper, agents to the Municipality, 54 St. Mary Axe, London, E.C.

Mr. J. Buchanan, Engineer-in-Charge at Hammersmith, has resigned. The vacancy is to be filled by a rearrangement of the present staff.

The Stoke-on-Trent Electricity Department want a Switchboard Attendant (see an advertisement on another page).

The Hammersmith Electricity Department want an Engineer-in-Charge (see advertisement on another page).

TRADES DIRECTORY OF ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
Fletcher (H. J.) & Co., Bridge Works, New North Rd., London, N.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sloog, H., 51, Anson Rd., London, N.W.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

HEATING AND COOKING APPARATUS.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
The Bastian Electric Co., Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Phœnix House, King William St., E.C.

LADDERS.
Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
"Lamlok," 18, Ranelagh Gdns., Hammersmith, W.
London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.

LAMPS (Incandescent)—*contd.*
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

MECHANICAL STOKERS.
Underfeed Stoker Co., Ltd., Coventry House, South Place, E.C.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

MOTORS AND DYNAMOS.
British Thomson-Houston Co.. Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Langdon-Davies Motor Co., 110, Cannon St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PACKING.
Dermatine Co., Ltd., Neate St., London, S.E.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons. Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

RUBBER GLOVES.
Ingram (J. G.) & Son, Hackney Wick, N.E.
Moseley (D.) & Sons, Ltd., Ardwick, Manchester.

STEAM ENGINES AND TURBINES.
Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk St., W.C.
Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
United States Metallic Packing Co., Ltd., Bradford.

SWITCHGEAR.
British Thomson-Houston Co., Ltd., Rugby.
Dorman & Smith, Ltd., Ordsal Electrical Works, Salford.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Electric Control, Ltd., 177, Reid St., Bridgeton, Glasgow.
Ellison (George), Warstone Lane, Birmingham.
Ferguson, Pailin & Co., Ltd., Hr. Openshaw, Manchester.
Ferranti Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Igranic Electric Co., Ltd., 147, Queen Victoria St., E.C.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.

TECHNICAL BOOKS.
Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
Constable (Archibald) & Co., Ltd., 10, Orange St., Haymarket, W.
Crosby Lockwood & Son, 7, Stationers' Hall Court, E.C.
Macmillan & Co., Ltd., St. Martin's Street, W.C.

TELEPHONES.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Graham (Alfred) & Co., St. Andrew's Works, Crofton Park, S.E.
Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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SUMMARY

THE outline of a linking-up scheme for the whole of the country has now been prepared by the Joint Committee of I.M.E.A. and Power Companies. The country has been divided into districts, for each of which a local Committee is to be appointed. When this has been accomplished a general meeting will be called with a view to furthering any proposals that may be generally approved. Details have also been prepared of a scheme for linking-up power stations in the Lancashire and Cheshire area. For the present the Committee confines its attention to twenty-six stations, each of which generates and transmits at 6,600-volts, 3-phase, 50-cycles. The estimated expenditure is £281,397. It is calculated that the present average coal consumption per unit generated for the stations concerned, namely, 3·24 lb., will be reduced by not less than 0·5 lb. With coal at 17s. 6d. per ton, this represents an annual saving on the present output of the undertakings in question of about £82,000. Steps are being taken to obtain the appointment of a Statutory Joint Board of local authorities in the area with power to make working arrangements with power companies and railway companies, there being at present difficulties in the way of appointing a Statutory Joint Board consisting of representatives of local authorities and companies (pp. 384–386).

IN an article this week on the design of traction motors, the writer discusses the problem of the provision of closer gear centres necessitated by the use of smaller car wheels. By careful design of the magnetic circuit of the motor the centre of the gear-wheel axle is brought nearer that of the armature and pinion axle (p. 387).

A QUESTION connected with the pull obtainable with solenoids is given in our "Questions and Answers" column (p. 387).

WE give further instances of the manner in which the construction of overhead transmission lines in this country is hindered by difficulties with landowners, public bodies, and others (p. 388).

WE publish an article on the possibilities of the commercial use of steel instead of copper for house wiring. The section of the latter is often larger than necessary to carry the current for reasons of mechanical strength, and it is argued that in some such cases steel would be cheaper than copper (p. 388).

AMONG the subjects of specifications published at the Patent Office last Thursday were searchlights, destruction of submarines, heating elements, controllers, and dynamos (p. 389).

THE classes organised by the Institution of Electrical Engineers for the purpose of giving a preliminary training to disabled sailors and soldiers as electricity sub-station attendants are about to be resumed. Engineers are asked to communicate (p. 389).

MR. E. T. WILLIAMS, writing on the question of electricity supply in Great Britain, points out that certain misunderstandings have arisen in regard to the proposals of the Institution of Electrical Engineers, based upon his Paper to the Board of Trade (p. 390).

THE use of canal water for condensing purposes at Wigan is to be discontinued. A disastrous breakdown some months ago is attributed to this.—A surprisingly good result was obtained with the Diesel engine plant at Kingston-on-Thames last year as regards fuel costs compared with the steam plant (p. 391).

EXTENSIONS at the Rotherham Electricity Works are contemplated; the Worcester Electricity Department requires transformers and switchgear; loans of £5,000 and £3,190 are to be applied for at Wednesbury for plant extension and rotary converter (p. 391).

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE, S.W.
ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.B., COMMANDING.

Officer for the Week: Platoon-Commander A. Gerard.

Next for Duty: Platoon-Commander W. J. A. Watkins.

Appointments: Co.-Sergt.-Major H. de F. Birkett to be Platoon-Commander; Sec.-Commander J. W. Roger to be Sergt-Major; Sec.-Corpl. R. T. Morris to be Sec.-Commander; Sapper E. C. Taylor to be Sec.-Commander; Sec.-Corpl. E. S. D. Carter to be Sec.-Commander (All dated October 3rd.) Sapper J. W. Stubbs to be Sergt.-Instructor of Physical Exercises (dated October 5th).

Mon., Oct. 16th: Technical for Platoon No. 9 at Regency Street. Squad and platoon drill, Platoon No. 10. Signalling class. Recruits' drill, 6.25 to 8.

Tues., Oct. 17th: School of Arms, 6 to 7. Lecture, 7.15, "Duties in Camp and Quarters," Co.-Commander Hyam. Range practice.

Wed., Oct. 18th: Instruction class, 5.45. Platoon drill, Platoon No. 2. Range practice.

Thurs., Oct. 19th: Platoon drill, Platoons Nos. 5 and 6. Range practice.

Fri., Oct. 20th: Technical for Platoon No. 10, Regency Street. Squad and platoon drill, No. 9. Signalling class. Recruits' drill, 6.25 to 8.25.

Sat., Oct. 21st: N.C.O.'s class, 2.30, Co.-Commander W. Hyam.

Sun., Oct. 22nd: Entrenching at Otford. Parade Victoria (S.E. & C.Ry.) Booking Office, 8.45 a.m. Uniform, haversacks, water-bottles. Midday ration to be carried. Railway vouchers will be provided

Arrangements for the Week.—*Friday, Oct. 13th.*—Electro-Harmonic Society. Smoking Concert, Holborn Restaurant, 8 p.m.

Saturday, Oct. 14th.—Birmingham and District Electric Club, Swan Hotel, New Street. Discussion on "The Effects of the War on the Electrical Trade." 7 p.m.

Obituary.—We regret to record the death of Mr. Percy Webberley at his home at Longton, Staffordshire, on the 6th inst, at the early age of thirty-seven. Mr. Webberley was the assistant electrician in the Board of Trade Electrical Standards Laboratory from August, 1908, until June, 1915, when he retired through failing health. He was educated at Mason University College, Birmingham, 1896-1899, where he took the Electrical Engineering Diploma. He was an improver at Messrs. Belliss & Morcom, and acted for some time as assistant in the electrical engineering department of the Northampton Institute, Clerkenwell. After this he was employed by the Westminster Electric Supply Corporation for four years in testing and maintaining instruments under Mr. C. O. Grimshaw, during which he took first place in laboratory work in the electrotechnics examination, and second in the theoretical work at Finsbury Technical College. He matriculated at the London University in 1902. He was selected from a considerable number of candidates for the post in the Board of Trade, on account of his knowledge of electric meters and of electrical measurement and testing. He was a careful and accurate worker and a genial and attractive colleague.

NATIONAL ELECTRIC POWER SUPPLY

Outline of the Main Linking-up Scheme: Details of the Lancashire and Cheshire District Proposals

THE Joint Committee of the I.M.E.A. and Power Companies, which was appointed a few months age to consider the linking-up of electric supply undertakings throughout the country, has now got seriously to work. As pointed out on page 297 of our issue for August 3rd, two Committees have been formed and are working in collaboration in this matter. One is a Committee of the Institution of Electrical Engineers, which is devoting its attention to the requirements of the country as a whole specially from the engineering aspect; whilst the Joint Committee has been considering the more immediate questions of organising and linking-up existing undertakings. The Chairman of the I.E.E. Committee is Mr. R. A. Chattock (Chief Electrical Engineer, Birmingham), and the Chairman of the Joint Committee of the I.M.E.A. and Power Companies is Mr. W. A. Chamen (Engineer and Manager of the South Wales Electrical Power Distribution Co.).

At an earlier period of the year the supply station engineers in Lancashire and Cheshire formed a Committee under the Chairmanship of Mr. S. L. Pearce (City Electrical Engineer, Manchester), with the object of preparing a scheme for inter-connecting the principal supply stations in the two counties. Preliminary particulars of the scheme were given in our issue for June 8th, page 207.

Fig. 1.—Suggested "districts" for each of which local schemes might be prepared. The portions surrounded by dotted lines represent industrial areas.

In May a circular letter was addressed by the Board of Trade to all electric supply station authorities in the United Kingdom (Electrical Engineering, May 25th, page 187), calling attention to the very considerable savings that could be effected by the adoption of an arrangement for interconnection and joint working of electric supply undertakings, including inter-connection with stations supplying tramways and railways, and this promise of official support has greatly stimulated the movement.

We have now received details in the form of a Memorandum of a proposal which the Joint Committee of the I.M.E.A. and Power Companies has placed before supply station engineers, and, simultaneously, a copy of an interim report of the Committee dealing with the inter-connection of the Lancashire and Cheshire electricity supply systems. As will be seen from the particulars given below, the Joint Committee's plan is to "district" the country with local Committees, and the Lancashire and Cheshire Committee now comes into the scheme as one of these District Committees.

Joint Committee's Main Scheme.

The Joint Committee has arrived at the following conclusions with regard to the suggestion contained in the Board of Trade letter:—

(1) That linking-up is important for the purposes of saving fuel, saving labour, and increasing the security of supply, and, in the future, making for economy of capital.

(2) That the question of linking-up should be considered broadly from the national point of view, and having in mind not only the saving of fuel, but the interests of consumers in obtaining a cheap supply of electricty for all purposes.

(3) That while the generation of electricity as distinct from its distribution must be considered broadly and irrespective of the present areas of electricity supply undertakings, clearly all existing rights must be respected, and existing areas must not be interfered with as regards distribution.

(4) That the linking-up of many existing stations could be carried out immediately without further legislation.

(5) That in order to arrive at a better understanding of the problem, committees of engineers representative of local electricity supply interests, should be appointed in various parts of the country.

To facilitate the formation and work of the local committees the country has been sub-divided provisionally into areas as indicated on the map, but if local circumstances, known better to the engineers in any area make it desirable to alter the definition of these areas, it is open to them to suggest any such alteration. It is requested that the local committees will communicate to the joint committee the results of their labours, thus rendering available for the use of all the experience gained in each locality, the joint committee, of course, being prepared to assist the local committees in every possible way. A general meeting will then be called with a view to furthering any proposals that may be generally approved.

Attached to the memorandum is an explanatory note giving a brief history of the electric supply industry in this country, pointing out how experience has shown that the comparatively small areas of the companies and local authorities working under Provisional Orders are in many cases insufficient to enable the advantage to be taken of modern improvements in plant. It is also evident, it is pointed out, that the liability to

compulsory purchase imposed upon the undertakings of companies working under Provisional Orders has restricted enterprise and retarded the development of electric supply. Since some of the companies operate in very important districts immediate measures should be adopted to deal with this difficulty. One of the most important problems both at the present time and in the future is the better utilisation of our coal supplies. An extension of these problems consists in utilising the coal in such a way as to avoid the waste of its available constituents and by-products. This object can be attained in a satisfactory way only by treating the coal at central points on a large scale. Electricity offers by far the most economical and convenient method of distributing the power from these centres.

The memorandum contains a schedule asking for full particulars of the various undertakings in a form more or less familiar now to supply station engineers.

An appendix gives interesting actual results of two linking-up schemes. In the first instance two power-stations, each carrying about 7,000 kw. of load, were linked-up at a cost of £3,000, the link having a capacity of 3,000 to 4,000 kw. The following advantages were immediately shown :—

By shutting down one station each night (12 midnight to 6 a.m.) and week-ends (from noon Saturday to 6 a.m. Monday) (1) The plant load factor at each station has been increased from 67 to 72 per cent. (2) The total saving of coal per annum in both stations has been 2,000 tons, and it is anticipated that this saving will be increased to 3,000 tons.

The second instance was that of a power-station having a maximum load of 2,000 kw., linked-up with another power-station having a maximum load of 15,000 kw., and the following economy in coal consumption was achieved :—(1) During the second year of working "linked-up," the coal consumption of the smaller station was reduced by 2¼ lbs. of coal per unit on all units generated by that station. (2) The combined saving of coal, due to interchange of current, in the second year of working, amounted to 5,500 tons.

Fig. 2.—Lancashire linking-up scheme. Existing generating stations are indicated by heavy black dots; E.H.T. mains by thick black lines; the double thin line represents L. & Y. Railway E.H.T. mains, and the black dotted lines proposed E.H.T. links.

In addition to the saving of coal the linking-up has resulted in the following further advantages :—(1) Greater security of supply; (2) Reduction in the number of shifts run and wages paid; (3) Reduced maintenance charges due to fewer plant hours run; (4) Facility for carrying out repairs when stations are shut down; (5) A saving in future capital expenditure owing to reduced amount of stand-by plant and the use of larger generating sets.

In another appendix a similar linking-up proposal is outlined for a station having a maximum load of 3,000 kw., running for eight hours (one shift) a day only, and possibly not at all on Sundays, linked-up with another power-station having a maxi-

mum load of 20,000 kw. It is shown that such an arrangement would not only result in a saving to the nation of 2,500 tons of coal per annum, but a saving to the two electric supply undertakings of, say, £3,000 per annum, including wages, &c., which would give a return of 10 per cent., even if it cost £30,000 to connect up.

THE LANCASHIRE AND CHESHIRE SCHEME.

As a matter of historical accuracy it should be stated that the Committee of Lancashire and Cheshire supply station engineers was actually at work a few weeks prior to the issue of the Board of Trade letter. The Committee held its first meeting on May 16 last and decided to consider the problem in the first place from its engineering aspect. For the purpose of the scheme the undertakings in the area were divided into six groups, namely :—

Group A.—Altrincham Supply Co., Eccles Corporation, Lancashire & Yorkshire Railway, Middleton Corporation, Manchester Corporation, Salford Corporation, Sale U.D.C., Stretford U.D.C., Stockport Corporation, Trafford Power & Light Supply, Ltd.

Group B.—Bolton Corporation, Bury Corporation, Heywood U.D.C., Lancashire Power Co., Leigh Corporation, Radcliffe U.D.C., Rochdale Corporation, South Lancashire Tramways Co., Wigan Corporation.

Group C.—Ashton-under-Lyne Corporation, Glossop Supply Co., Oldham Corporation, Stalybridge, Hyde, &c. (Joint Board).

Group D.—Accrington Corporation, Blackburn Corporation, Burnley Corporation, Colne Corporation, Darwen Corporation, Nelson Corporation, Preston Corporation Tramways, Preston Electric Light Co., Rawtenstall Corporation.

Group E.—Birkdale & District Co., Birkenhead Corporation, Bootle Corporation, Hoylake and West Kirby U.D.C., L. & Y. Railway (Formby), Liverpool Corporation, Liverpool & District Co., Liverpool Overhead Railway Co., Mersey Railway Co., Mersey Power Co. (Runcorn), Ormskirk Co., Prescot & District Co., St. Helens Corporation, Southport Corporation, Wallasey Corporation, Warrington Corporation.

Group F.—Alderley & Wilmslow Co., Crewe Corporation, Chester Corporation, Macclesfield Electricity Co., Northwich Electric Supply Co.

A technical census of these undertakings has been made, but at an early stage the Committee came to the conclusion that no useful purpose would be served by the inclusion of Group F, and consequently this has been dropped out of the scheme. The map shows that extra-high-pressure mains have been laid to a much greater extent in the districts of Groups A, B, and C than in the others, and that the scheme for interconnecting these groups could be carried out at a comparatively small cost and little delay. The majority of the undertakings included in Group D can also be conveniently linked up with each other, but the interconnecting of this group with Groups A, B, and C is not provided for at present. The district comprised in Group E is a very wide one, and to interconnect all these undertakings at the present time would entail a capital expenditure out of proportion to the realisable savings. This does not, however, rule out the possibility of adjacent undertakings in this district linking up by mutual agreement.

The Committee, after careful consideration, therefore decided to confine its attention to Groups A, B, C, and D, comprising thirty-two undertakings.

In Group A the cost of linking-up Sale and Altrincham with the other undertakings could not be justified at present, and this also applied to the two Preston undertakings in Group D. There remained, therefore, twenty-eight undertakings, including the Lancashire & Yorkshire Railway Co.'s 25-cycle system and the Eccles municipal undertaking. The Committee makes no proposals for dealing with these two undertakings, the first on account of the expenditure involved, and the second because the necessary information has been withheld. Of the remaining twenty-six undertakings the majority are operating on the 3-phase 50-cycles A.C. system, with 6,600 volts as the pressure of generation and transmission.

The Committee has come to the conclusion that if these twenty-six undertakings in Groups A, B, C, and D are interconnected as indicated the present average coal consumption per unit generated, namely, 3·24 lb., could be reduced by not less than 0·5 lb. per unit. With coal at 17s. 6d. per ton, this reduction represents an annual saving on the present output of the undertakings in question of about £82,000.

Having arrived at these preliminary conclusions, the Committee proceeded to ascertain more definitely the views of the Government Departments concerned, and correspondence took place with the Board of Trade. A deputation consisting of Messrs. Pearce (Manchester), Purrett (Lancashire Electric Power Co.), Welbourn (National Electric Supply Co.), Robertson (Salford), Watson (Bury), and Wheelwright (Blackburn), waited on the Board of Trade on July 13, when the view was put forward that as the whole scheme was part of a national effort to effect economies, and as the return on the outlay involved was so substantial, the Government might favourably consider the question of providing the necessary capital to effect the interconnection proposals on such terms as would prove a strong inducement to those concerned to proceed with the scheme. It was indicated, however, that there was no hope of this being done, but on behalf of the Treasury it was said that the granting of the necessary loans would be facilitated, provided the Local Government Board and the Board of Trade were satisfied with any proposals which might subsequently be submitted to them.

Considerable discussion ensued with regard to the procedure which would be necessary to give effect to the Committee's proposals. The deputation, while being of opinion that much could be done by voluntary co-operation amongst the various authorities, favoured the appointment of a Joint Committee or Joint Board, representative of the whole of the supply undertakings concerned, but the representatives of the Government Departments pointed out the extreme difficulty, if not impossibility, of setting up statutory joint boards on which power companies, railway companies, and local authorities were represented. Under Section 8 of the Electric Lighting Act of 1909, the Board of Trade has powers to set up Joint Boards or Joint Committees of Local Authorities, and it was inquired if the power companies were essential to the scheme. The deputation was not only emphatic that power companies are essential but also pressed the desirability in the national interests of arriving at some working scheme which will include the whole of the supply authorities and not simply one section. The deputation considered that powers should be given to a Joint Committee or Joint Board with a view to co-ordinating the electrical supplies in the various districts, in the matter of raising capital, the allocation of expenditure on an equitable basis, to adjust the running hours of existing generating stations in order to obtain the maximum fuel saving, to lay down general rules for determining the charges to be made for reciprocal supplies, stand-by supplies, and bulk supplies, to act in an advisory capacity in regard to future extensions, and to appoint from time to time the necessary officials to act in an advisory capacity to the Board under powers which might hereafter be conferred by the Government.

As a result of this interview the Committee, having regard to the loss of time which would be involved in securing fresh legislation for setting up statutory boards comprising companies and local authorities, are of opinion that it is desirable to proceed under Section 8 of the 1909 Act by means of which Joint Boards or Joint Committees, representative of local authorities, may be constituted. It is further recommended that this Joint Committee should be empowered to enter into working arrangements with the power companies, including the use of the companies' existing mains and with regard to laying mains in the areas of the companies. In order to develop the proposals set forth, it is further recommended that a conference of all local supply authorities interested should be held, such a conference to be presided over by a Government official. The next step would be to apply to the Board of Trade to set up the Joint Committee or Board, but pending the appointment, undertakings favourably situated might enter into voluntary arrangement for joint working, provided that any works undertaken are so arranged as to form part of the whole co-ordinated scheme at a later date, the capital expenditure or annual charges being recoverable from the Statutory Joint Committee or Board when appointed. To achieve this object it is proposed that the local authorities interested should temporarily appoint a Joint Committee to deal with the matter.

ESTIMATED EXPENDITURE.

Attached to the report are six appendices, two of which deal with the estimated capital expenditure involved in the proposal. To interconnect the existing systems in Group A it is estimated will cost £58,839; Group B, £31,375; Group C, £23,900; Group D, £83,500; and to interconnect Group A with Groups B and C, £83,783, making a total of £281,397.

These estimates are based on the abnormal prices now ruling for materials, and with one or two exceptions allow a section of not less than 0·15 square inch of copper on all new mains and sufficient capacity of transforming plant to enable any undertaking to receive not less than 3,000 kw. from the adjacent undertakings with which it is connected.

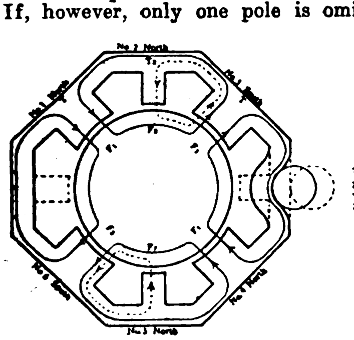
The total length of mains to be laid is as follows :—Group A, 9,450 yards; Group B, 22,220 yards; Group C, 8,800 yards; Group D, 48,400, and Group interconnections, 20,680 yards, making a grand total of 109,550 yards, or about 62¼ miles. The total capacity of mains and/or transformers involved is 45,000 kw.

TRACTION MOTOR DESIGN

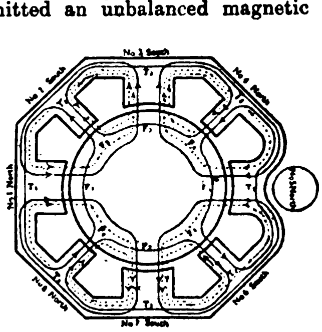
Provision for Closer Gear Centres

As is well known to the motor designer, the dimensions and general arrangement of traction motors are limited by the design of the car on which they are to be mounted. The tendency to use smaller wheels has, therefore, introduced new problems in motor construction, one of the first being to overcome the handicap of shorter gear centre distance. One way of doing this, described by Mr. F. W. McCloskey in the *Electric Railway Journal*, is to omit the commutating pole located on the axle side of the motor and proportion the remaining commutating poles so that they will produce the same effect with regard to commutation as would be obtained ordinarily with the full number of poles.

In city service where economy of power requires that the accelerating current be as low as possible, it is desirable in most cases to use the maximum gear reduction possible; that is, it is desirable to use as small a pinion as is consistent with the required strength under the teeth and as large a gear as will permit proper clearance beneath the gear case. A reduction in wheel diameter requires a corresponding decrease in the diameter and number of teeth of the gear to maintain sufficient clearance beneath the gear case. Using a minimum sized pinion, as before, to maintain maximum reduction, this decrease of gear diameter results in the shortening of the gear centre distance, which means bringing the centre of the armature closer to the centre of the axle. This, in turn, results in a restriction of space in the axle region and a difficulty in obtaining room for the field winding. Omitting the commutating pole on the axle side permits the armature to be brought nearer the axle. If, however, only one pole is omitted an unbalanced magnetic



1. DISTRIBUTION OF MAGNETIC FLUX IN A FOUR-POLE MOTOR HAVING TWO COMMUTATING POLES.



2. DISTRIBUTION OF MAGNETIC FLUX IN A MOTOR HAVING FOUR MAIN AND FOUR COMMUTATING POLES.

pull results, which in most cases can be obviated best by omitting the opposite pole as well.

In a machine having four commutating poles and four exciting poles, about 70 per cent. of the ampere-turns on the commutating poles serve simply to neutralise the magnetomotive force of the armature. The remaining 30 per cent. are for the purpose of producing sufficient field in the commutating zone to neutralise the sparking voltage in the short-circuited coils. Therefore, in omitting, say, two of the commutating poles, it is necessary only to add to the remaining poles the magnetising turns, or about 30 per cent. of the turns of the poles omitted. In actual practice it is necessary to add a little more than 30 per cent. and also somewhat to lengthen the commutating poles axially to take care of saturation, &c., but a considerable net saving in copper and iron is secured. Efficient designs, using half as many commutating poles as main poles may be worked out for motor sizes up to about 50 h.p. Above this size the commutating poles are apt to become bulky. This design, besides saving in space, has an advantage in reduced weight, copper loss and less likelihood of grounds, because of their being fewer coils to ground.

It is usual to think of the action of the commutating poles as being independent of the main poles. This is true only in the case of machines having the same number of commutating poles as main poles, and when the windings on the latter are symmetrical; that is, when each pole has the same number of turns. The flux distribution in a four-pole motor having two commutating poles is diagrammatically represented in Fig. 1. It is of interest to note the distribution of flux in different portions of the frame, as compared with that of a non-commutating pole machine. It is obvious that between poles 3 and 4 the flux will be the same. Between poles 2 and 3 the total flux carried by the frame is greater than on non-commutating machines by one-half of the commutating pole flux. Between poles 1 and 2 it is less by one-half of the commutating pole flux. It therefore follows that the frame may be made of smaller sections between poles 3 and 4 than between poles 1 and 2, or poles 2 and 3. The latter two sections will, however, be made the same because with reversal of direction of rotation, the conditions between poles 1 and 2 will be the same as shown between poles 2 and 3 in the diagram.

In the design of motors of about 150 h.p. and up, such as are used in railway service, as a rule the motor space is not as restricted as in the case of street cars. However, cases occasionally arise where the gear centre distance must be made shorter than normally would be required.

The conditions here involved are different from those in the smaller motors for street cars, in that it is customary to have a main pole at the axle instead of a commutating pole. One advantage of this is that the brushes and brush holders are more readily accessible, inspection being made usually from underneath the car instead of through a trap in the floor of the car, as is the case generally with street cars. The location of the main pole at the axle requires that the brush holders be rotated on the 45-deg. line, bringing them nearer the axle, where they are more readily inspected.

Shortening the gear centre distance results in a reduction of the space for the main field windings at the axle side. This condition may be overcome by proportioning the exciting coil at the axle side with as many turns as the restricted space will permit, and designing the top and bottom coils with a greater number of turns, such that the sum of the ampere-turns on the side and top coils will be sufficient to produce the required flux. The coil on the other side of the motor opposite the axle should, of course, have the same number of turns as that on the axle side.

In the above method of winding, the design of the commutating poles is somewhat influenced by the number of coils on the main field poles. With the same number of coils on all main poles the design of the commutating poles would be practically independent of that of the exciting coils.

The distribution of flux in the several magnetic circuits is shown in Fig. 2. From the diagram the following deductions are obvious: First, the flux in main poles 3 and 7 exceeds that in main poles 1 and 5 by an amount equal to twice the flux induced in each of the commutating poles by the unbalanced magnetomotive force due to T_3—T_1 turns on poles 3 and 7. Second, the flux in commutating pole 2 is weakened and that in commutating pole 4 is strengthened by the flux induced in them by T_3—T_1. These two statements are equivalent to saying that the magnetic unbalance is proportional to the difference in the number of turns on the main poles. For, if the unbalancing of the main field turns is carried so far as to make the flux induced in pole 2 by the ampere-turns T_3—T_1 equal or exceed that induced in this pole by T_2, the flux in commutating poles 2 and 6 will be completely neutralised or even reversed.

These statements are all based on the assumption of unsaturated magnetic circuits. When the magnetic circuits are partly saturated, the difference between the fluxes in poles 1 and 3 and also in poles 2 and 4 will be reduced. In other words, the weakening of poles 2 and 6 is greater than the strengthening of poles 4 and 8, with a result of weakened commutating flux. This can be compensated for by additional turns on the commutating poles or by more liberal design in other respects.

QUESTIONS AND ANSWERS

BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of* 10s. *will be paid for the answer which we consider shows the greatest merit, and* 5s. *for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

QUESTION No. 1,513.

What strength of pull in pounds can I obtain from the average electric light system, with a solenoid? I require the magnet of the solenoid to move ½ in.; how should such a solenoid be made?

(*Replies must be received not later than Monday, October 23rd.*)

A Locking Lampholder.—In the article on page 329 of last week's ELECTRICAL ENGINEERING, describing a new locking lampholder, it should have been stated that the patented batten holder embodying the lock in question is marketed by Messrs. "Lamlok," whose address is now 36 Rusthall Avenue, Chiswick.

OVERHEAD TRANSMISSION LINE WAYLEAVES

We are able to amplify the notes in our last issue on the question of wayleaves for overhead transmission lines. The statements given below are the results of experience in various parts of the country, and strengthen the general case already set out:—

Difficulties with regard to wayleaves may be set out under four headings, and examples are given illustrating each:—

1. Prejudice and fear of private individuals against both overhead and underground mains passing through or over their property.
2. The exorbitant charges for crossing bridges.
3. The overbearing and excessive charges of public bodies, County Councils particularly.
4. The lack of Government action to overcome these difficulties, the present Government facilities being too slow to be of practical use.

Examples of No. 1.—It was desired to run a main to the northern part of the district, and by crossing the land of a farmer a considerable sum would have been saved. The landowners were anxious to oblige, as it was anticipated power would be required by them in close proximity to the proposed route of main. A farmer, however, holding a lease of the land, absolutely refused to permit the cable to cross his farm, whether from fear of a force he did not understand, or prejudice, it is difficult to say, but he stated a rental of £5 per pole would not tempt him to permit the line to pass across the land he rented. The land in question was partly waste Black Country land, and the rental offered for the poles would certainly have exceeded the value of crops, even if a roadway had been kept open under the route of the cable across his land. A number of half-starved fowls were trying to get a living on the land, which was practically rubbish, and nearly covered with pools.

It was further desired to run a cable along a public cartway across some waste land, the road not having been taken over by the public authority. The owners refused to allow this, and a considerable additional sum had to be spent in taking a longer route, owing to the long delay under the Board of Trade regulations for compelling the owner to agree. In this case the owner lives in a southern county, and could not therefore have possibly been inconvenienced. The only reason at any time given was that "Even in these times a man can do what he likes with his own land!"

Example of No. 2.—It is an anomaly that public utility services should be denied the use of bridges without having to pay exorbitant charges. A sum of 5s. per annum would be ample compensation for the keeping of records of the mains and pipes passing over these bridges, but the usual charge is £1 per bridge if the structure of the bridge is not affected, with increased rentals up to as much as £5 per bridge if the structure is affected. Water companies are, in many cases, exempt, owing to the fact that they were in existence when the other authorities obtained power to build bridges; but electric companies, not being in existence at the time, have no protection and are entirely at the mercy of the bridge owners, although the bridge forms part of a public road and the cable to be laid is for the public convenience.

Example of No. 3.—Power companies frequently have difficulties in dealing with public bodies, and have to submit to the most arbitrary demands. It was desired to lay a connecting main between two portions of a district, and without more than trebling the expense this could not be done without running for a short distance through a public footpath alongside a County Council school. A private owner would have taken, without question, an acknowledgment of from 1s. to 2s. 6d. per annum, but the Council demanded £1 per annum, plus legal charges, and although the agreement was not executed until late in the year, £1 had to be paid for the few remaining months to the end of their financial year. The suggestion was made that as this was a public utility main to feed the system of lighting the schools and the residences of the community around, and as the land was owned by the community, a smaller acknowledgment would be in keeping with the easement granted. The supply authority, however, was peremptorily told that these were the only terms, and discussions of others were useless. In addition to the £1 per annum, the whole of the footway had to be kept in repair.

County Council charges have been found heavier than those of private owners, negotiations longer to complete, and conditions in every way more stringent.

Example of No. 4.—The delay of Government action under the powers granted by the Electric Lighting Acts for compelling owners to come into line has made this privilege of very little general use. It is only when a delay of months can be allowed for that any hope of success can be entertained, and the speed with which concessions required when Government war work is at stake are rushed through only makes the leisurely procedure of peace time more exasperating. Taking the case mentioned under heading No. 1, a saving of 400 yards of large E.H.T. feeder main, costing £1 per yard, would have been made, if the Board of Trade had insisted on permission to cross rough open land surrounded by disused pits not likely to be of use to anyone. When a blank refusal was given by the owner, negotiations were opened under the Electric Lighting Acts at the beginning of September with the Board of Trade. Correspondence extended to the end of November in the year in question, and it was obvious would so extend until the next year, and as the main had then become one of extreme urgency, the longer route had to be taken. Had the procedure of sending an inspector on to the spot been followed, the position was so obvious as to have received immediate settlement in our favour.

(*To be continued.*)

STEEL CONDUCTORS FOR HOUSE WIRING

Possibilities of meeting the demand for a cheaper system of electric wiring for existing houses and cottages are discussed by the *Electrical Review and Western Electrician* in a recent leading article. The compulsory experiments being made by Germany at present in the use of iron wire as a substitute for copper will, it is believed, result in a continuation of this practice after the war. Our American contemporary points out that installations in small residences invariably use more copper in the conductors than is necessary from the electrical standpoint, and the high price of copper at the present time makes this item more important than it formerly was. The smallest size of wire that is permitted for either main or branch circuits is No. 14 B. & S. gauge, which has a rated carrying capacity of 15 to 20 amperes, according to the kind of insulation with which it is provided. Wire as large as this is required for mechanical reasons, since a smaller size would be more likely to become broken and lead to trouble and possibly to hazards. The carrying capacity of No. 14 wire is much more than sufficient for most branch circuits, since such circuits are limited to a connected load of 660 watts, which upon a 110-volt circuit is equivalent to six amperes. Copper is chosen as the material for conducting wires on account of its high conductivity. It is evident here that the conductivity is much higher than is necessary from electrical considerations, and a cheaper material could be substituted without detriment.

Such a material can be made available in the form of insulated iron or soft-steel wire. Such a wire would have about seven times the resistance of a copper wire of the same cross-section, and in small sizes the magnetic permeability would be of no consequence in alternating-current circuits of commercial frequencies, so far as reactance and skin effect are concerned.

Not only has No. 14 copper wire higher carrying capacity than is necessary on the typical branch circuit, but the voltage drop due to its resistance is much smaller than would be permissible in good practice. A length of 100 ft. of this wire has a resistance of approximately one-quarter ohm, and with a return wire would have a resistance of about one-half ohm. The maximum current of six amperes permitted in a branch circuit would cause a drop of three volts in this length of wire if the load were concentrated at the distant end. For the same drop under the same conditions a soft-steel wire of the same size could be but 14 ft. long. If steel wire of size No. 12 B. & S. gauge were substituted, the length of the circuit might be 23 ft., or if the load were distributed along the circuit the length could be even greater.

The maximum load here considered represents eleven 60-watt tungsten lamps, or 26 lamps of the 25-watt size, which would be more frequently found in residences of the type here under consideration. The National Electrical Code, however, permits not more than 16 outlets to the circuit, so that if lamps of this size are used the greatest possible load is not more than two-thirds of that above considered; hence the likelihood of overload or of excessive drop in voltage in case iron or steel wire were substituted for the copper is very remote.

Steel wire is ordinarily drawn in sizes not represented in the B. & S. gauge, but the common sizes of copper wire have been considered above in order to make a comparison. It is really immaterial what exact size of wire is chosen in this connection, but it should be kept in mind that a smaller size of steel wire will meet the mechanical requirements of strength as well as the minimum now permitted in copper wire. On particular circuits where loads might be heavier than the minimum, it will be possible to use copper wire even though steel wire were resorted to upon the smaller main or branch circuits. No change in fittings would be necessitated by the use of steel wire.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published October 5th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

12,999/15. **Searchlights.** E. A. Sperry. A searchlight lamp in which the electrodes are run at a very high current density, and are cooled except at the top by forced circulation of air through hollow parts of the carbon holders, and provision is made for rotating the positive carbon.

13,080/15. **Searchlight Lamps.** J. Brockie and Johnson & Phillips, Ltd. A projector arc lamp with means for regulation comprising a compressed-air motor of which the speed and direction of running are governed by a valve electrically controlled in accordance with the condition of the arc.

13,354/15. **Destruction of Submarines.** T. McDonald. A system for destroying enemy submarines, in which a bomb connected to a trailing cable is fired from a gun so as to throw the cable across the submarine. The cable is then hauled in until contacts carried near the end of it touch the metal of the submarine, when a signal is given so that the bomb may be electrically exploded.

4,901/16 (*100,230*). **Heating Resistances.** L. Heller. A composition for embedding heater resistance wires in, consisting of an insulating mass composed of 70 per cent. pure ceramic clay, 20 per cent. pulverised white quartz, 5 per cent. crushed mica, and 5 per cent. silicious sand. The wires are embedded while the compound is in a plastic state, and the whole is hardened by heating.

1,246/16 (*101,362*). **Controllers.** Igranic Electric Co. (*Cutler-Hammer Mfg. Co.*) A multiple switch controller adapted for either power or hand operation, with a common switch operating shaft. A single electromagnet is arranged to control the connection between the controller and the actuating motor, and also serves as a means to retain the controller in the "on" position, subject to release upon failure of voltage. The switches are automatically locked in the closed position to relieve the operating means from the load, and are positively moved to the open position when released.

5,391/16 (*100,394*). **Dynamos.** Allmanna Svenska Elektriska Aktiebolaget. D.C. shunt or separately excited dynamos, in which the short-circuit current is limited by the provision of a counteracting compound winding. The exciting winding is in inductive connection with a separate winding, passed by the load current in such a manner that on variation of the load current, an E.M.F. is induced in the exciter circuit opposite to the E.M.F. induced by the same variation in the exciting circuit from the counteracting compound winding.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Hall [Coating wire] 13,224/15.

Dynamos, Motors, and Transformers: Neuland [Dynamos] 13,287/15; Heys (*Neuland Patents, Ltd.*) [Dynamos] 13,480, 13,482, 13,483, and 13,484/15; Schroeder [Commutator machines] 13,561 and 13,562/15; A. H. Neuland [Dynamos] 5,526/16 (*101,447*).

Ignition: A. H. Midgley and C. A. Vandervell & Co. [Magnetos] 3,299/16.

Switchgear, Fuses, and Fittings: Mavor & Coulson, Ltd., and Lawrence [Switches] 16,502/15.

Telephony and Telegraphy: Graham [Telephone transmitters] 16,207/15.

Traction: Thomas [Power transmission applicable to vehicles or ships] 12,949/15.

Miscellaneous: Mackenzie (*Kehrhahn*) [Signalling apparatus] 12,039/15; Summerfield [Portable writing lamp] 13,110/15; Otto [Arrangement for producing short uni-directional high-tension current impulses] 13,129/15; Hefford [Portable lamps] 16,469/15; J. J. Steward [Magnetic compass] 9,332/16 (*101,466*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Arc Lamps: Planiawerke A.G. fur Kohlenfabrikation [Electrode with capillary passages] 5,524/16 (*101,471*).

Instruments: British Westinghouse Elect. & Manf. Co. [Measuring instruments] 12,824/16 (*101,474*).

Switchgear, Fittings, &c.: H. C. Adam [Indirect and semi-indirect lighting fittings] 11,661/16 (*101,472*).

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

22,712/02. **Single-phase Motors.** V. A. Fynn. A system of starting single-phase commutator motors, involving extra slip rings on the armature.

The following are the more important Patents that have become void through non-payment of renewal fees.

Traction: S. M. Young [Track circuit signalling] 13,746/03; M. Crossman, E. Despons, and British Pneumatic Railway Signal Co. [Electro-pneumatic railway signalling] 14,159/04.

TRAINING DISABLED SAILORS AND SOLDIERS

The classes organised at the Northampton Polytechnic Institute by the Institution of Electrical Engineers, in co-operation with the London County Council, for the purpose of giving a preliminary training to disabled sailors and soldiers as electricity sub-station attendants, are about to be resumed. Up to the present some 40 men have been admitted to the courses, of whom 25 have been placed in electricity supply undertakings, the remainder having either found other situations or been unable to complete their course.

The courses are free to the men, and the work consists of demonstrations and exercises in the first principles of electrical engineering and of physics, practical work in the electrical and physical laboratories, and demonstrations in the power-house of the Northampton Institute. By the courtesy of some of the London supply companies, visits are also paid in the last week of the course to sub-stations and generating stations in the London district, and instruction is given by the men in actual charge of the stations.

A third batch of 20 men will begin their course about the middle of October, and will be ready to take up employment as probationers about the middle of November. Engineers having vacancies which could be offered to these men are requested to communicate with Dr. Walmsley, Principal of the Northampton Polytechnic Institute, Clerkenwell, London, E.C., who will also be pleased to send application forms for admission to the courses, with full particulars, to disabled sailors or soldiers wishing to join.

Increased Electricity Charges.—A further increase of 10 per cent. in the charges for electricity is to be made at Wolverhampton, and 5 per cent. at Bermondsey.—The Dover Electricity Committee also recommends an increase of 10 per cent. on all accounts other than those subject to contract terms.—In reply to a notification from the Twickenham & Teddington Electric Supply Co., stating that its charges for all purposes will be advanced by a further 10 per cent., making 20 per cent. in all, the Twickenham Town Clerk has been instructed to reply that, under the agreement for public lighting, the company cannot charge in any circumstances a higher rate than 2½d. per unit, and that the Corporation is not prepared to pay a higher rate.—At Ravensthorpe the lighting charges are to be increased by 10 per cent. and the power charges by 15 per cent., with, in each case, a discount of 2½ per cent. for prompt cash.

War Tribunals.—In the case of a shift engineer at the Winchester power-house, aged 19, for whom the borough electrical engineer applied for exemption before the local tribunal last week, it was decided that, as the man was engaged in a reserved occupation, the tribunal could not order him to join the Army. It was, however, intimated to the Corporation that a substitute should be found and the man released.

Mr. J. K. Brydges, the Eastbourne Borough Electrical Engineer, applied before the local Tribunal for exemption for two leading stokers and his personal assistant. The former received conditional exemption and the latter eight weeks' exemption, the Tribunal suggesting that Mr. Brydges should obtain a lady assistant.

Faraday House Journal.—The Michaelmas Term journal of Faraday House contains a large quantity of matter relating to students and old students who are on active service. The Principal, Dr. Alexander Russell, begins a series of "Notes on Electrical Engineering," which are to be mainly of a mathematical nature, and will discuss important problems which are being considered by engineers at the present time.

CORRESPONDENCE

ELECTRICITY SUPPLY IN GREAT BRITAIN.

To the Editor of Electrical Engineering.

Sir,—In the discussion which is proceeding on the proposals for the reform of the electricity supply of Great Britain the issues, which were originally fairly clear, are becoming involved, due to misconception and misunderstanding. Partisanship—that barrier to reform—if tending to grow must be checked. It is very unfortunate that the word *nationalisation* has been mentioned, for in the paper I had the honour to read before the I.E.E. on this subject (Electrical Engineering, April 20, p. 141) there is no proposal for the nationalisation of our electricity supply, to which I am opposed.

We are practically unanimous that reform is needed, and the proposals advanced by me were that we should attain that reform by (*a*) co-operation, and (*b*) co-ordination of control. We must co-operate where centralisation would produce the best results, as, for example, in many instances in the generation and bulk distribution of electricity, but should remain independent where no advantage would accrue from centralisation, viz., in the distribution and application of electricity.

We *already have* Government control of electricity supply in a not very satisfactory form, viz., the Home Office, Local Government Board, Board of Trade, and Parliament itself. There is no co-ordination of control, no live connection between the supply undertakers and the Government, and no scientific plan for the electricity supply of the country as a whole.

The proposal in the paper was to take this existing Government control and vest it in a professional public board, which could watch over the industry as a whole, both in the interests of the public and the legitimate interests of the supply undertakers. In so far as the powers of this board would be contained in a Parliamentary Bill, it would really be what might be termed a quasi-Government Board, which is very different to a Government Department. The Board would have Government authority through its Bill without many of the restrictions of Government Departments. The Port of London Authority is a somewhat similar organisation, and the remarkable success of its administration is its justification. Again, the Public Trustee Office is run on less restricted lines than an ordinary Government Department, and is self-supporting, and its success is shown in the rapid rise of this office.

Under this Board enterprise would be extended, and it was to be part of the Board's duties to *encourage private enterprise to the maximum extent.* The Board would operate in conjunction with existing undertakers when this was to the interests of all, and would operate in such districts as were unprovided for, and for which no private or municipal enterprise sought powers. Shareholders of companies should realise that if reform can be effected in which their interests are protected and in which their further enterprise is encouraged, then they have everything to gain by it. Those companies in particular whose powers are not in perpetuity would be given a new lease of life under the scheme.

Another point made in the paper was that drastic alterations and the immediate sweeping away of existing generating stations was not proposed. The proposed Board would lay out plans for the supply of this country to meet its requirements, say, fifteen years hence, and then see that all new plant—new stations—new interconnecting mains, etc., etc., were devised to form part of the final scheme. The necessity for and value of a transition period was insisted on both for economic and administrative reasons.

To sum up—reform by co-operation and co-ordination was to take place on the basis of protecting and advancing the interests of existing undertakings and those who had invested their money in them, whether shareholders or Corporations. It is possible to do this and at the same time benefit the country as a whole, because the electricity supply industry is rapidly growing. The saving in coal alone under the scheme would amount to several millions sterling per annum. The owners of the undertakings, as well as the general public, would participate in this beneficial result.

Moreover, it must not be lost sight of that if the supply industry is not reformed from within it will be taken that the industry is not capable of effecting such much-needed reform. This leaves it open to attack from without, when probably more drastic and less equitable action would result. Apart from this it is the duty of all to look at the problem from the standpoint of the national need and seek to attain the desired end. It is useless to expect to achieve this result by taking a short and narrow view. Any particular series of proposals if looked at from the standpoint of the immediate results might not be considered advantageous, but studied with a view to the ultimate result, for which all undertakings would be working on a preconceived and scientific plan, would certainly be carried out. In this connection, the establishment of a Public Electricity Board would inspire confidence and justify the broader view being accepted by individual undertakings. There is no reason to fear that because powers are vested in a Public Board sympathetic to electricity supply, personal interests will suffer—we may reasonably expect the opposite. So long as these interests are adequately protected in the Bill, and we can be assured those responsible will see to this, then the shareholders should work for the reform as being in *their* intarests and the interests of the country.

Finally, let us not make the foolish mistake of mistrusting those who represent the industry in positions of influence. The recommendation (2) of the Council of the I.E.E. to the Board of Trade (Electrical Engineering, July 13, p. 269) means, I take it, neither more nor less than it states, and the Council of the I.E.E. deserves the thanks and encouragement of the industry for all the trouble it has taken in this matter. When we read the names of those who constitute the Committees dealing with this reform in electricity supply, we can be assured by their past and present achievements that they will only take such steps as they are satisfied will be steps of true progress, which includes the interests of the industry itself as well as those of the greater public. I hope the time may not be far distant when the Council, with the support of the whole industry and shareholders, may be able to boldly approach the Government and ask for the Parliamentary authorisation of a complete scheme somewhat as outlined in the paper discussed by the Institution.

Yours faithfully,

Ernest T. Williams.

London, October 3.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

A Treatise on the Theory of Alternating Currents. By A. Russell. Vol. II. 566 pp. 8¾ in. by 5½ in. 239 figures. (Cambridge: The University Press.) Second Edition. 15s. net; abroad 15s. 9d.

This second edition of Dr. Russell's well-known work includes several additions and alterations which have been rendered necessary by the progress made in perfecting the theory of alternating current machinery since the appearance of the first edition ten years ago. The theory of armature reaction has been rewritten, approximate solutions only being given, as accurate solutions are obviously not warranted so long as we are unable to take hysteresis accurately into account. The author has also developed a novel method of graphic harmonic analysis which is useful in practice. The theory of the induction motor and of power transmission has been rewritten, a chapter on hyperbolic trigonometry being added to give assistance with the latter. Comparatively novel machines, such as the La Cour motor converter, the synchronous booster, the split-pole converter, and the frequency transformer, are briefly described for the purpose of illustrating theory, though a full discussion of their value is not attempted. The work will need no recommendation to those who are acquainted with the first edition, and it will doubtless be much consulted by students and others who wish to bring their knowledge of A.C. theory up-to-date.

Dynamo and Motor Attendants and Their Machines. By F. Broadbent. 212 pp. 7½ in. by 5 in. 107 figures. (London: S. Rentell & Co., Ltd.) Eighth edition. 2s. 6d. net, by post 2s. 10d.

This well-known and popular handbook has been thoroughly revised by the author, and rendered more comprehensive by the inclusion of some 40 new illustrations and over 50 additional pages. A new and most useful chapter on accumulators has been added, dealing with many practical points in construction, erection and maintenance. A certain amount that has become obsolete has been removed and the work more than maintains its already established reputation for clearness, accuracy and utility.

LOCAL NOTES

Bolton: *Street Lighting.*—The Electricity Committee has passed a resolution suggesting that a joint-meeting of the Electricity and Gas Committees should be held at an early date to consider the question of control and supervision of the street lighting.

Hornsey: *Linking-up.*—The Council has appointed two of its members, together with the Borough Electrical Engineer and Town Clerk, to represent them at future meetings of the conference in reference to linking-up generating stations in the London and Greater London area.

Kingston-on-Thames: *Electricity Accounts.*—The annual report and accounts of the electricity undertaking for the year to March 31st show a deficit, after meeting capital expenditure, of £630 against a deficit of £1,295 in the previous twelve months. Mr. J. E. Edgcome, the borough electrical engineer, states that the number of consumers increased by 99 during the year, but adds that the result of the working of the undertaking, with respect to lighting, is still prejudicially affected by the war. On the other hand, current sold for power purposes has considerably increased, mainly owing to the demand for munition purposes. The two horizontal Diesel engines have worked satisfactorily throughout the year, and an interesting comparison of fuel costs between the steam plant and oil plant is made. Generating 181,981 units, the cost of coal for the steam plant was £2,492 and the cost per unit 3·286d. The oil plant, on the other hand, generated 974,220 units at a fuel cost of £1,883 and a unit cost of 0·464d.

Wigan: *Report on Electricity Works.*—The Investigation Committee which was appointed to inquire into the cause of a disastrous breakdown at the electricity works in December last, as a result of which the post of Borough Electrical Engineer is now vacant, has reported. The causes of the breakdown are enumerated as the use of unsuitable canal water, which has been the subject of adverse analysts' reports during the past eight years, and the non-cleaning, or very inefficient cleaning, of the boilers, resulting in insufficiency of boiler capacity. The Committee makes a number of recommendations for preventing a repetition of these troubles, including the abandonment of the use of canal water. The report has been adopted by the Corporation.

CATALOGUES, PAMPHLETS, &c., RECEIVED

OZONE GENERATORS.—A new form of ozone apparatus for laboratory and research work, for which considerable efficiency is claimed, is described in a new leaflet issued by Ozonair, Ltd. (96 Victoria Street, S.W.).

REFLECTORS.—A post-card list from the Benjamin Electric Co., Ltd. (1A Rosebery Avenue, London, E.C.), gives particulars of steel conical reflectors and opal glass reflectors.

A RING HINGE MEMO BOOK.—We have to thank Messrs. J. Frankenberg and Sons, Ltd. (Greengate Rubber and Cable Works, Salford, Manchester), for a copy of a small ring hinge pocket memo book which they are issuing to their friends. It has a celluloid cover and consists of some 50 memo pages, 4in. by 2¼in.. the whole being held together by two rings, affording ease of refill.

POCKET LAMPS.—An illustrated leaflet from the Compton Trading Co. (Forest Road, Forest Gate, Essex), gives prices and particulars of a number of designs of electric pocket flash lamps and dry battery refills.

HALF-WATT LAMP FITTINGS.—We have received from Engineering & Arc Lamps, Ltd. (Sphere Works, St. Albans, Herts.), an illustrated list of specially designed fittings suitable for half-watt nitrogen-filled lamps. A variety of alternative designs is shown, particularly suitable for works or industrial lighting. The patterns shown comprise fittings for interior lighting, indirect and semi-indirect and outdoor lighting, or for exposed positions. Some of the fittings are supplied complete with cut-out and substitutional resistance for use on high voltage (or for series lighting), and robust hexagonal lanterns are also illustrated as an alternative to globes. All these specialities are manufactured at St. Albans.

FITTING FOR FLEXIBLE LEADS.—The same firm also send us particulars of an appliance known as the "Nevaknot" adaptor, comprising a spring for taking up the slack in the leads to electric irons, portable electric tools, &c., and preventing them becoming entangled or knotted.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

British West Indies.—The Government of Grenada is inviting tenders for an electricity works at St. George. Tenders to the Colonial Secretary, Grenada, British West Indies, by October 31st. Particulars at 73, Basinghall Street, E.C.

Rotherham.—In anticipation of important extensions at the electricity works, the Corporation is negotiating for additional land at an estimated cost of £7,000.

Russia.—Considerable discussion has been going on in the lay Press as to the possibilities of trade in Russia, and in this connection special attention may be directed to the openings for electrical and engineering goods. It is a matter to which electrical engineers have already had their attention drawn, but a reminder may not be out of place.

Wednesbury.—Application is to be made for sanction to borrow £5,000 for extensions at the power house, and £3,190 for a rotary converter for the King's Hill district. It is stated that applications for supply from this district have been received of a value to cover the cost of the machine.

Worcester.—The Electricity Department requires ten 60-kw. transformers and the necessary switchgear. Application is to be made to the Local Government Board for sanction to a loan of £1,000 for this purpose.

Miscellaneous

Glasgow.—The District Board of Control require six or twelve months' supply of electric lamps and fittings for its various establishments. Clerk, 266 George Street, Oct. 24th.

Ireland.—The Great Northern Railway Co., of Ireland, requires a twelve months' supply of electric lamps and fittings, electric cable wires, arc lamp stores. Secretary, Amiens Street Terminus, Dublin, November 2nd.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith and Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £141 to £143 (last week £139 to £141).

Price Advances.—The General Electric Co., Ltd. (Head Office, 67, Queen Victoria Street, London, E.C.), notify advances on their catalogue prices of small motors and carbon brushes, and upon a number of items in Section S of the 1914 reprint. The terms quoted for certain articles appearing in Section W of the 1916 catalogue have been withdrawn and prices will be quoted on application.

"Sherardizing".—The Cowper-Coles Manufacturing Co. (Sunbury-on-Thames) notify that sherardizing is now undertaken at that address by them, and that they also undertake the erection of sherardizing plants for every description of iron-work which it is desired to render rustless.

Condensing Plant.—The Mirrlees Watson Co., Ltd. (Glasgow), have recently received orders for 34 sets of condensing plants, practically all for war service work, and of varying steam duties up to 130,000 lb. steam per hour.

APPOINTMENTS AND PERSONAL NOTES

Mr. J. Nauheim has resigned from the chairmanship of the British Thomson-Houston Co., Ltd. The present Managing Director, Mr. H. C. Levis, has been appointed Chairman and will also retain the managing directorship.

The salary of Mr. J. A. T. Barnes, Borough Electrical Engineer at Kendal, has been increased from £175 to £200 per annum.

Mr. E. Grime, of Leyton, has been appointed station superintendent at the Barking electricity works at a salary of £160 per annum, in place of Mr. W. Fraser, recently resigned.

A fitter-driver is required for a small station near London. (See an advertisement on another page.)

TRADES DIRECTORY OF
ADVERTISERS IN "ELECTRICAL ENGINEERING."

(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

ACCESSORIES (Electric Light and General Supplies).
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
Fletcher (H. J.) & Co., Bridge Works, New North Rd., London, N.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
Lundberg (A. P.) & Sons, Liverpool Rd., N.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sloog, H., 51, Anson Rd., London, N.W.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

HEATING AND COOKING APPARATUS.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
The Bastian Electric Co., Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Phœnix House, King William St., E.C.

LADDERS.
Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
"Lamlok," 18, Ranelagh Gdns., Hammersmith, W.
London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.

LAMPS (Incandescent)—*contd.*
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

MECHANICAL STOKERS.
Underfeed Stoker Co., Ltd., Coventry House, South Place, E.C.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

MOTORS AND DYNAMOS.
British Thomson-Houston Co.. Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Langdon-Davies Motor Co., 110, Cannon St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PACKING.
Dermatine Co., Ltd., Neate St., London, S.E.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons, Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

RUBBER GLOVES.
Ingram (J. G.) & Son, Hackney Wick, N.E.
Moseley (D.) & Sons, Ltd., Ardwick, Manchester.

STEAM ENGINES AND TURBINES.
Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk St., W.C.
Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
United States Metallic Packing Co., Ltd., Bradford.

SWITCHGEAR.
British Thomson-Houston Co., Ltd., Rugby.
Dorman & Smith, Ltd., Ordsal Electrical Works, Salford.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Electric Control, Ltd., 177, Reid St., Bridgeton, Glasgow.
Ellison (George), Warstone Lane, Birmingham.
Ferguson, Pailin & Co., Ltd., Hr. Openshaw, Manchester.
Ferranti Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Igranic Electric Co., Ltd., 147, Queen Victoria St., E.C.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.

TECHNICAL BOOKS.
Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
Constable (Archibald) & Co., Ltd., 10, Orange St., Haymarket, W.
Crosby Lockwood & Son, 7, Stationers' Hall Court, E.C.
Macmillan & Co., Ltd., St. Martin's Street, W.C.

TELEPHONES.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Graham (Alfred) & Co., St. Andrew's Works, Crofton Park, S.E.
Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

ELECTRICAL ENGINEERING

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With which is Incorporated

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SUMMARY

Some illustrated particulars are given of the Sperry searchlight, as described in a recently published patent specification (p. 394).

The Electrical Vehicle Committee is in communication with the Local Government Board as to the length of the loan period in respect of electric vehicles (p. 395).

The Bradford Electricity Department sold 5,000,000 more units during the year just ending (October) than in the previous twelve months. Bulk supplies and power and heating supplies now account for more than half the total output (p. 395).

Apprenticeship in the electrical engineering trade was the subject of Mr. A. P. Trotter's Presidential Address to the Association of Supervising Electricians. He does not think any special organisation is necessary for the electrical trade, having regard to facilities which exist and which were outlined in his address. A period of four years is recommended, although in some cases three years would be sufficient (p. 396).

We publish an article on the revival of the metric agitation, showing the enormous expense to which British manufacturers would be put by substituting the metric system for the English system of weights and measures (p. 397).

The proposal made at the British Association this year that all who use coal uneconomically should be compelled to pay a special tax is supported by Mr. R. A. Chattock in his Presidential Address to the Birmingham Association of Mechanical Engineers (p. 398).

The starting up of air-compressor motors is dealt with in our "Questions and Answers" column (p. 399).

Among the subjects of specifications published at the Patent Office last Thursday were dynamo and motor improvements. A patent for electrodeposition of tin is opposed. Patents for cooling searchlight mirrors and A.C. motors expire this week after a full life of 14 years (p. 400).

The question of the law as regards payments under street lighting contracts which cannot be carried out owing to the lighting restrictions has been brought to the attention of the Local Government Board (p. 401).

An expenditure of £20,600 has been sanctioned at Chesterfield; a sub-station is to be built at Norwich; new plant is required at Liverpool; and electric lamps are required by the L.C.C. and the South African Railways Administration (p. 401).

1st LONDON ENGINEER VOLUNTEERS

Headquarters, Chester House, Eccleston Place, S.W.
Orders for the week by Lt.-Col. C. B. Clay, V.D., Commanding.

Officer for the Week: Platoon-Commander H. de P. Birkett.
Next for Duty.—Platoon-Commander N. E. Brown.

Mon., Oct. 22nd: Technical for Platoon No. 9 at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits Drill, 6.25 to 8.

Tues., Oct. 24th: School of Arms, 6 to 7. Lecture, 7.15, "The Meaning of and Necessity for Drill," Co.-Commander Fleming. Range Practice.

Wed., Oct. 25th: Instructional Class, 5.45. Platoon Drill, Platoon No. 3. Range Practice.

Thurs., Oct. 26th: Platoon Drill, Platoon No. 7. Range Practice.

Fri., Oct. 27th: Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25 to 8.25.

Sat., Oct. 28th: General Parade, 2.45. Uniform, for Drill. Recruits' Drill, 3.0.

Sun., Oct. 29th: Entrenching at Otford. Parade Victoria (S.E. & C. Ry.) Booking Office, 8.45 a.m. Uniform, haversacks, water-bottles. Midday rations to be carried. Railway vouchers will be provided.

Unless otherwise indicated, all drills, &c., will take place at Headquarters.

NATIONAL ELECTRIC POWER SUPPLY

In our issue for August 24th, p. 321, we gave some exclusive information with regard to the Joint Committee of municipal and company interests which has been formed to deal with the linking up problem in Greater London. Having regard to the existence of this body, the National Power Supply Committee, to whose report we referred at length last week, does not propose to convene a Committee for the Greater London area, as it is hoped that the London Committee will act in conjunction with the National Committee.

At a meeting of the London Committee on Friday it was resolved that: "A formal notice be sent to the secretaries of the National Committee stating that a conference had been formed of representatives of private and public interests to consider the best method of linking up generating stations in Greater London area.

The London Committee is constituted as follows, viz.:—

Companies.—Charing Cross; City of London; County of London; Kensington & Knightsbridge; London Electric; Metropolitan; and Westminster.

Municipalities.—Hammersmith; Battersea; Finchley; Croydon; Hackney; Stepney.

The London County Council, the North Metropolitan Power Supply Co., and the Great Eastern Railway are also represented, and the Joint Honorary Secretaries are Messrs. F. J. Walker (St. James's & Pall Mall Co.) and Fred Tait (Poplar).

The "B.E.A.M.A." Journal.—The October number of the "B.E.A.M.A." Journal makes, as usual, good reading. There are a number of interesting articles on topics which are just now very much to the fore such as science and industry, which is dealt with by Professor Miles Walker; the relations of employers and employees, upon which Dr. Arthur Shadwell speaks, and the influence of increased production in the solution of the problems of peace, by Mr. T. C. Elder. In addition, some valuable information is given as to electrical industries in Spain, and the Editorial matter concludes with an illustrated technical description of the electrical equipment of textile mills.

Institution of Electrical Engineers.—The opening meeting of the 1916-17 session will take place on Thursday, November 9th, 1916, at 8 p.m., when the premiums awarded for papers read or published during the past session will be presented, and the eighth Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," will be delivered by Dr. Alexander Russell, Vice-President.

Arrangements for the Week.—*Friday, Oct. 20th.* Institution of Mechanical Engineers at Institution of Civil Engineers, Great George Street, Westminster. "Trials on a Diesel Engine and Application of Energy Diagram to Obtain Heat Balance," by the late Lieut. Trevor Wilkins, presented by Prof. Burstall. 6 p.m.

Monday, Oct. 23rd.—Institution of Electrical Engineers, Western Section. Merchant Venturers' Technical College, Bristol. Chairman's address by Prof. David Robertson. 5.10 p.m.

Tuesday, Oct. 24th.—Institution of Civil Engineers. James Forrest lecture: "The Development of Appliances for Handling Raw Materials and Merchandise at Ports and other Large Centres of Traffic," by Sir John P. Griffith. 5.30 p.m.

THE SPERRY SEARCHLIGHT

A GOOD deal of attention has been drawn in America to some experimental searchlight projectors of the Sperry type recently put up in the United States, and some extravagant claims have been made in the Transatlantic Press of their power. We have already referred briefly to the main differences between the Sperry lamp and other recent developments in the same direction, and a few details of the lamp, as described in Mr. E. A. Sperry's British patent (No. 12,999/15), which was published last week, will be of interest.

The specification commences as follows :—

This invention relates to high-power searchlights, the electrodes of which are operated at high current density. It has been found that the principal causes of deterioration and loss of candle-power in such lights are the vaporisation and oxidation of the carbons behind the crater of the positive carbon, and behind the tip of the negative carbon. The chief object is to prevent vaporisation and oxidation of the electrodes and enable the current to be introduced without melting the contacts or brushes, as with the high-current density employed, especially in the negative, the impedance is large, and the electrodes are heated to the kindling temperature thereby. According to the invention I provide an electrode holder which is adapted to permit of a cooling blast of air or similar gaseous medium being circulated through the holder in such a manner that the medium passes through, and is directed or conducted from the holder without coming in contact with the arc. Thus the holder may comprise a jacket for protecting the electrode from all gases up to a point immediately adjacent the arc whilst permitting of the cooling blast being circulated close to the arc, the air being conducted to the holders through hollow legs forming supports for the holders and communicating with a blower for supplying the air. Each holder at its rear end is provided with an arrangement of rollers adapted to support and feed the electrode, whilst the positive holder is also provided with a worm wheel whereby the electrode may be rotated within the holder. The current is led to the positive electrode by means of an arrangement of copper bars carried by a plug inserted through an opening in the holder, and provided with detachable wearing blocks attached to the ends of the bars for making contact with the rotating electrode. The positive electrode preferably consists of a cored carbon, whilst for the negative electrode a cored carbon of smaller diameter may be employed.

The positive and negative carbon holders are shown in section in Figs. 1 and 2, and the general arrangement of the complete apparatus is seen in Fig. 3, where the hollow legs serving as air ducts as well as supports, and the small motor-driven blower supplying the cooling air are clearly seen. The positive holder (Fig. 1) comprises a metallic body, but the forward portion (A) is made of quartz or other refractory material, and the inner part is ribbed to give a lay cooling surface to the air passing between it and the outer case or shield, and the ribs are cut away to give a suitable distribution of air. The air escapes through a slot in the upper part of the shield. By employing an intensive cooling, means for the current may be introduced much nearer the arc, since otherwise the carbon close to the arc would be too hot to rest the metallic brushes against. The brushes themselves (B) are made of silver attached to copper bars and held against the rotating and forward moving carbon by springs fitted with an arrangement of equalising links. The mechanism for rotating and feeding the carbon is mounted on the rear of the holder. The rotating gear is worm driven, and the feed is controlled by a star wheel (S) tripped by an adjustable stop (T). The position of the stop is governed by the position of the positive crater and may also be adjusted by hand, so that the crater may always be kept at a predetermined position with respect to the reflector. The arrangement may be such that when the circuit is open the stop will turn the star wheel through one tooth per revolution, and thus feed the carbon somewhat slower than its normal burning rate, and when the circuit is closed the stop will move the star wheel through two or more teeth. The rate of feeding may also be under the constant control of the operator.

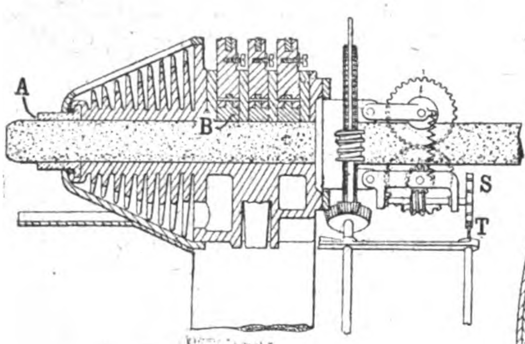

Fig. 1.

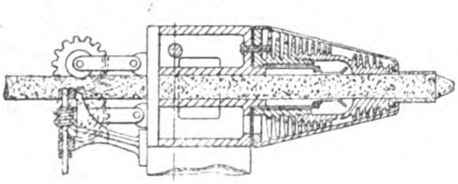
Fig. 2.

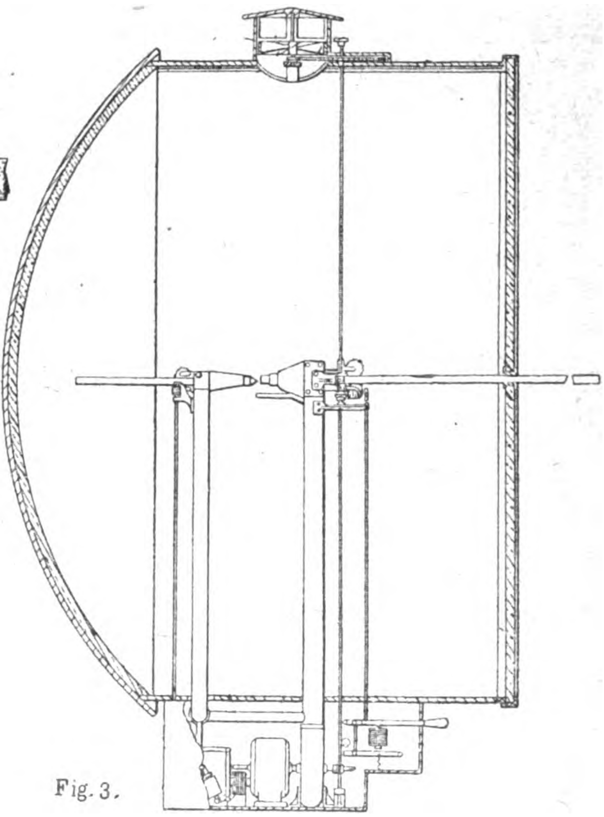
Fig. 3.

The negative holder is generally similar, but with simplified mechanism, as the negative carbon is not rotated and as there is less heat to dissipate : a simpler form of spring brush, which is seen in Fig. 2, is used.

It will be realised that neither holder is moved for bringing about the feeding of the carbons. The negative holder is, however, mounted on a swinging support and is moved for striking the arc. The striking mechanism is contained in the box under the lamp, in which is also placed the small motor driving the cooling fan and also working the feed and carbon rotating mechanism. The feed control gear is in the forward end of the box. The motor also drives an exhaust fan for cooling the case and removing smoky vapours from the arc. The specification continues :—

By feeding the carbon through the cooling casing, which also serves as a holder, and by rotating the carbon, a means is not only provided for effectively cooling the carbon and shielding it from the action of the oxygen of the air, which remains at a fixed position adjacent to the arc, and equalise the cooling effect by the rotation, but also the burning of the arc itself is improved by the rotation, which aids in the formation of a well-defined crater, thus permitting of the employment of much longer carbons than could otherwise be used.

Some further particulars of the apparatus as actually made in the United States are to be found in the *Journal*

of the United States Artillery, where it is stated that a specific brilliancy of 500 c.p. per sq. mm. is obtained in the crater as against about 150 c.p. for an ordinary pure carbon arc. A lamp of the size used in the 36 in. lamp gives a maximum of over 95,000 c.p. with a very wide angle of high intensity, and the smaller crater materially reduces the angle of spread of the beam. Fig. 4 gives comparative candle power distribution curves for a Sperry lamp and an ordinary arc. The arrangement of the lamp and its mechanism is generally similar to that described in the

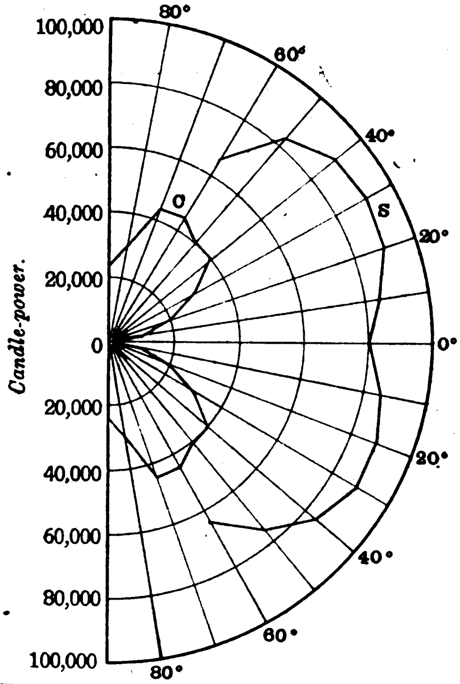

FIG. 4.—CANDLE-POWER DISTRIBUTION CURVES.
S. Sperry Lamp.
C. 36-in. U.S. Navy Standard Lamp.

patent except for constructive details. The carbon feed is controlled by a thermostat arrangement. The thermostat is mounted on the drum and is so placed that when the positive carbon burns out of the local point of the mirror the light from its crater is brought on to the thermostat, causing feed of the positive carbon until the local point is again reached. The feed of the negative carbon is controlled by a solenoid connected directly across the arc. The arc voltage is about 75 volts. The Sperry Gyroscope Co. has developed lamps for the 24 in., 30 in., 36 in. and 60 in. sizes of searchlights, and manufactures special carbons for them, no longer depending upon supplies from Germany as formerly.

THE ELECTRIC VEHICLE COMMITTEE

AT the September meeting of the Electric Vehicle Committee Mr. E. S. Shrapnell-Smith, representing the Commercial Motor Users' Association, was elected vice-chairman. It was resolved to invite the Institute of Cleansing Superintendents to nominate a representative to sit upon the committee. It was decided to send a circular letter to British automobile manufacturers, and another to British Electrical manufacturers, suggesting that they should consider the question of taking up, after the war, the manufacture of electric vehicles.

A communication has been received from the Recorder of the Standards Committee of the Society of Automobile Engineers of America, stating that breakages of charging plugs and receptacles made according to the present standard had indicated the necessity of increasing the length of the outer metal protective casing of the receptacle, and that the American standard design had accordingly been altered by increasing the length of the said outer casing by 11/16 in. (18 mm.). The committee has suggested to the British Engineering Standards Committee the desirability of altering the British standard in a similar manner.

A letter from the City Electrical Engineer of Bradford relative to the period of the loan authorised by the Local Government Board for the purchase of electric vehicles was considered. It appears that the loan for the three Bradford vehicles has been granted for a period of only four years. The secretary was instructed to write to the L.G.B. and state that the committee trust that the Board will be prepared, after the war, to consider evidence which the committee will be able to bring before them that the useful life of an electric vehicle is such as to warrant the granting of loans for a longer period than four years.

THE BRADFORD ELECTRICITY UNDERTAKING

Increased Output of 5,000,000 units

NOTWITHSTANDING the abnormal conditions still prevailing—or was it because of them?—the Bradford Electricity Department again did exceedingly well during the financial year ended October, 1916. The total output was 33,905,136 units, an increase of 5,161,418 units on the preceding year's total output, and representing the highest ever recorded in the history of the department. Of this increase bulk supply at 10,706,774 units accounted for 3,157,521 units and motive power and heating at 7,499,906 units accounted for 1,887,661 units, these branches of the supply now being responsible for more than half the total output. As was anticipated, in view of the lighting restrictions, the figures for private lighting, public lighting, and night supply for tramway purposes show a decrease as compared with the previous year's returns. The total of these decreases was, however, practically counter-balanced by the 269,197 additional units sold in connection with the day supply to the tramways department.

The total income for the year from all sources was £167,177, an increase of £19,438, but against this must be placed an increased expenditure on account of coal and other materials, wages, rates, &c., of £15,477, while additional charges to the extent of approximately £7,000 had to be borne in respect of interest, sinking fund, and income tax. The net profit on the year's working was £15,988, as against £18,956 in the previous year. In view, however, of the inflated prices of materials and labour now obtaining, and the fact that the department's tariffs have not been varied in any way since the war commenced, as has been the case in connection with the majority of electricity supply undertakings in the country, this result must be regarded as highly satisfactory. There was a slight increase in the works costs, from 0.526 to 4.540, whilst the average price per unit sold dropped from 1.140d. to 1.103d.

The sum of £7,500 is allocated to relief of rates, contributions to capital outlay have absorbed £2,200, special depreciation in respect of obsolete plant which has been sold is credited with £3,171, and £2,756 transferred to the depreciation and renewals account. The amount standing to the credit of that account at the end of last financial year was £32,735.

In February last it was reported to the committee that in order to cope with the greatly increased demands on the department, it was necessary that further extensions should be made at the Valley Road Electricity Works. It was decided to apply to the Ministry of Munitions of War for authority to expend £49,515 on additional boiler house and cooling plant, and £49,450 on additional engine room plant and switchgear. The Ministry of Munitions on March 18th, 1916, intimated their approval of the scheme of extension to the boiler house and cooling plant, but expressed their inability to authorise the installation of the additional engine room plant and switchgear required. A condition of the approval of the former portion of the scheme was that the sanction of the Local Government Board should be obtained, which sanction was duly applied for, and a loan obtained for £53,113 to cover the cost, the difference between this figure and the original estimate of £49,515 being mainly due to the continual increases in prices.

The rapidly increasing power load rendered it necessary for the committee again to consider the advisability of installing additional engine room plant and also the making of certain extensions to the extra high tension transmission system. Consequently in May last application was made to the Local Government Board for sanction to a further loan of £100,000 to defray the cost of the proposed works. The Board, however, on July 7th last intimated their inability to entertain the application.

The committee have since interviewed the Members of Parliament for the City, and explained the position of affairs to them with a view to obtaining their assistance in inducing the Board to re-consider the matter. In the meantime further applications for large supplies of energy have been received, and the question of extensions is still under consideration.

The structural steelwork of the boiler house extension already sanctioned is complete; two boilers are being erected; one cooling stack was placed in commission during August, and another should be in use shortly, while the foundation for the third is nearly finished. The economisers, fans, and chimneys are all practically ready for erection; the installation of the coal conveyor, the suction ash plant, and the feed

pumps is being proceeded with, and, although the extension will not be completed for at least another three months, there is every possibility of at least one boiler being put into service in time to assist in coping with the extremely heavy loads which it is anticipated will be experienced during the coming winter.

At Thornbury Sub-station additional cubicles have been built, and the necessary gear installed in order to give a supply to the Yorkshire Electric Power Co.

The maintenance of adequate stocks of coal during the year has occasioned considerable anxiety, all qualities having been very hard to procure. The railway companies have experienced much difficulty in handling the traffic, and owing to the scarcity of labour and the greatly increased quantity of coal required, in some weeks representing 50 per cent. over and above the amounts consumed during the corresponding periods of last year, the carting of the coal from the railway drops to the works has only been accomplished as a result of strenuous efforts. In order to surmount the cartage difficulty the Committee in May ordered two 5-ton "G.V." electric tipping wagons from the Jowett Motor Manufacturing Co. It is expected that these wagons will shortly be delivered, and it having been found to be practically impossible to keep the works clear of ash by means of horses and carts, it was later decided to purchase from Wolseley Motors, Ltd., a 3½-ton "Baker" electric tipping wagon. This wagon has been in regular use since June, and, in addition to relieving the position as regards the disposal of ash, has proved of considerable assistance in transporting materials urgently required for structural work.

The high price and shortage of petrol have, during the past twelve months, caused users of commercial motor wagons to give greater attention to the question of the use of electric vehicles, and a local firm has during that period taken up an agency in connection with vehicles of this type. In addition to the three tipping wagons which will shortly be in use by the department, there are not less than four other electric wagons either in operation or on order by firms in this city, and the committee have little doubt that the outcome of the adoption by the firms above referred to of electric wagons will be that considerably more of these vehicles will soon be seen in the Bradford streets, and a growing demand for electricity for charging such vehicles will be experienced.

The existing circumstances not justifying the continuance of publicity work to anything like the extent which prevailed before the war, the attention of the staff of this department has been more or less confined to the following up of direct inquiries received for supplies of power required for the driving of machinery for the production of material of national importance and the making of munitions. Many of the existing consumers have increased their power installations, while a number of large new consumers have been obtained, and a few firms who were already taking energy from the department applied for the renewal of their agreements, the periods covered by which were about to expire. As a result seven new bulk supply agreements have been entered into, the supplies covered by which aggregate 6,050 kilowatts, and the renewal of three expiring agreements representing supplies to the extent of 801 kilowatts, the total demand provided for under the ten agreements in question thus being 6,851 kilowatts. A stock of electrical apparatus is still kept in the showroom, and, when desired, demonstrations are given of the uses of electricity for lighting, heating, and cooking purposes.

Twelve employees of the department have joined His Majesty's Forces during the year, making a total of 60 since the war commenced. Of this number, however, three have been discharged from the Army as medically unfit, and have returned to duty, leaving 57 at present serving with the Colours. The committee regret to report that at least eight of the men have been wounded, although happily none of the injuries have proved fatal. In addition, one man is now a prisoner of war in Germany.

The prospects of the department as regards output for the year are exceedingly good, as the number of units sold during the half-year ended September 30th last represented an increase of more than 5,000,000 on the figure for the corresponding period of 1915, the increase for the half-year thus being equal to that shown for the whole of the previous financial year. It is only to be expected that during the remaining six months of the current year an equal or greater rate of increase will be maintained. As against the additional revenue received on account of this augmented output, however, must be placed the higher charges in respect of coal, wages, and materials used, which will affect the cost of all units generated. Capital charges will also show an increase by reason of the extensions which have been carried out during the year.

No great increase of economy in working can be anticipated, as the most efficient plant of the department is being run to the greatest extent possible, and it therefore follows that any additional load will have to be sustained by the older and less economical plant which has up to the present been mainly used for stand-by purposes.

APPRENTICESHIP IN THE ELECTRICAL TRADE

In his Presidential Address to the Association of Supervising Electricians last week, Mr. A. P. Trotter dealt with apprenticeship and followed up the remarks made on the same subject by Mr. A. H. Dykes, his predecessor (Electrical Engineering, October 14, 1915, p. 418).

Taking the apprentice system as it is understood to-day, Mr. Trotter is not in favour of evening classes, which require not only grit but a good physique. An apprentice should be bound to attend, and the employer should see that he did attend, chosen trade or handicraft day classes without loss of wages for periods of at least two or three hours per week or two mornings or afternoons every week in the theory and practice of his trade. For technical classes to be successful it was desirable that the teaching should be in close touch with the trade, and employers should be invited to take an active interest in the scope and method of training. This instruction, however, should not be a mere extension of the daily work carried on under the supervision of a teacher, but in the case of most trades it ought to consist of a study of general or scientific principles, illustrated or demonstrated by examples taken from the practice of the daily work. In some cases boys were apprenticed while still at school, and the last part of their school education was counted as part of their apprenticeship. To what extent school education should be specialised with a trade in view was a difficult question, but it certainly should not attempt to deal with technical details or handicraft. On the other hand, if time could be found in a normal curriculum for putting every boy through a course of elementary carpentering, perhaps one-half of them would be benfited thereby.

Courses of instruction were already provided in London by the L.C.C. at day schools to a greater extent than was generally known, and about 150 scholarships tenable at these schools were offered. Elementary and advanced evening classes for electrical wiremen were held at the Northampton Institute (Clerkenwell), and the South Western Polytechnic (Chelsea), whilst no doubt proposals for day classes would be considered. Having regard to the facilities that existed, no special organisation of the electrical trade in this connection seemed necessary. It only remained for firms to put themselves in touch with the facilities available.

The main advantage to the electrical engineering industry in encouraging the apprenticeship system was that it secured good workmen, thoroughly instructed in the craft. Whilst apprenticeship, say, in the straw hat making trade had its own value, in the case of electrical contractors engaged in wiring sound workmen became a matter of public importance. Ironmongers and decorators who had succeeded in putting up electric bells had gone on and tried their hands at wiring for electric light with disastrous results. The old period of apprenticeship for seven years, however, was too long in these days of competition and higher pressure. The period of modern apprenticeship should not exceed five years and in some cases of simple repetition work might be reduced to three. In general, four years seemed to be a suitable period for electrical contractors, because if there was a variety of work the apprentice might not have a chance of seeing it all during a period less than four years. Those wishing to receive more information on the subject of apprenticeship were recommended to communicate with the National Institution of Apprenticeship, 28, York Place, Baker Street, London, which has already arranged apprenticeships in 81 cases for electrical fittings makers, electrical fitters and turners, electrical instrument makers, electrical brass workers and armature and coil winders, and in 142 cases for general electrical engineers. The Institution helps in negotiating terms and inquiries into the teaching to be given, and sees that there is not an undue proportion of apprentices to skilled workmen. It provides forms of indenture and has an arbitration committee to settle any differences between masters and apprentices. The wide experience of this Institution should, concluded Mr. Trotter, be of great use to masters who wish to take apprentices but who do not fully understand the *pros* and *cons* of the situation.

REVIVAL OF THE METRIC AGITATION

ONCE again the small band of ardent pro-meterists in this country are trying to bring to the foreground their agitation for the total abolition of the inch, foot, yard, lb., and all the other familiar units of the British weights and measures system, and the substitution therefor of the centimetre and gram and their multiples. These enthusiasts, who have formed themselves into the "Decimal Association," apparently intend to take advantage of the state of unsettlement created by the war to spread their propaganda, and, if possible, rush through their reforms amidst the general upheaval which is likely to be caused in the settlement of after-the-war problems. Their chief supporters are found amongst schoolmasters and others who, having learnt the metric tables, have discovered that reduction from metres to decimetres merely entails the moving of a decimal point. The necessities of our foreign trade are to-day given as the all-important factor to be considered; because some foreign countries, with whom we desire to extend our trade, use the metric system, it is said we must not only print our catalogues and price lists in the metric system, but we must root out the British system entirely, even for manufacturing purposes at home. Unfortunately, such plausible reasons gain the support of a large number of people who are quite unaware that there is any objection to the proposal, and that any opposition to it exists. That there are very grave objections from an engineering point of view to the compulsory abolition of British units is shown in a recent article published by *Machinery*, which describes some of the changes involved in substituting the metric system for the English method of measurement, and the "frightful" cost to the British manufacturer. Considerable attention is now being directed in America, says our contemporary, to a document, "The Metric System in Export Trade," prepared by S. W. Stratton, director of the Bureau of Standards, which is a report to the International High Commission, meeting in South America, relative to the use of the metric system in export trade. This report was prepared with the apparent purpose of influencing legislation so as to bring about, by compulsory means, the adoption of the metric system in the United States.

In the opinion of experienced men, and especially those acquainted with the details of the requirements of the industries affected, such a change would, by breaking away from fundamental standards and having two standards in use in the shops instead of one, result in great confusion and enormous expense, and all this with no commensurate gain; indeed, with the saddling on industry of a system in many ways less satisfactory than the one we should lose.

In the report to the International High Commission five objections to the adoption of the metric system are mentioned and discussed by Dr. Stratton with the purpose of showing that they are trivial and should not stand in the way of making a change, of which (as claimed by him) the resulting advantages would more than offset the objections. The objections which he discusses are: (1) The difficulty of having two systems in use instead of one; (2) the cost of changing; (3) the loss of workmen's present familiarity with values represented in customary terms; (4) the loss of basic standards, or if old standards are maintained, the expression of their values in metric equivalents; (5) the loss of the present uniformity in the English-speaking world.

Dr. Stratton urges in answer to the first objection that we already have the two systems, and that therefore it is too late to consider this objection. He cites a number of manufacturers who are claimed by him to be using the metric system, thus proving that the two systems are being used together voluntarily and without difficulty. Among these manufacturers he names the Brown & Sharpe Mfg. Co., the Pratt & Whitney Co., etc., and in so doing gives to the public an entirely wrong impression. The Brown & Sharpe Mfg. Co. does not use two systems in its manufacturing in any sense whatever, but instead uses only the system based on the inch. The same is true of the Pratt & Whitney Co. Furthermore, it would be looked upon by the officials of these and other leading manufacturing concerns as a great calamity if the metric system should be forced upon their shops and their workmen, and yet they are listed in the report as examples showing how easily the metric system can be adopted. The inclusion of these names in the list given in the report is no doubt based on the fact that these companies make measuring tools having metric dimensions for the market; this, however, furnishes no ground whatever for any such misleading statement as that made in the report. Metric tools, such as micrometer calipers, are made with the general dimensions based on the inch, and when metric lead-screws are made for machines to go to countries which have adopted the metric system, diameters and lengths are made to customary English measurements. The cutting of the metric thread is simply a matter of gearing up the thread-cutting machine by the use of translating gears to give the required lead, and no workman in the shop needs to know anything whatever about the metric system to do the work.

The fact that the needs of foreign trade can be met in this way practically without using the metric system in the shops has been used as an argument by pro-meterists that, because work can be readily done in such a way, the metric system could easily be adopted by us. Such a view, however, simply shows ignorance of the fundamental difficulties involved in making a change to the use of the metric system. Some years ago, Dr. Coleman Sellers, in a paper before the American Society of Mechanical Engineers, explained some of the difficulties of using the metric system in an American shop. This paper was prepared as a warning to American manufacturers against metric legislation, which was then pending, and Dr. Sellers based his conclusions on twenty years' experience with the metric system at the works of William Sellers & Co., Inc., Philadelphia, Pa., where the system was introduced with the expectation that advantages would be found in its use, and an earnest effort was made to find such advantages. In this paper Dr. Sellers says:

"I propose to show why, after nearly twenty years' use of the metric system of measurement, I record my opposition to any enforcing legislation in this direction, because the metric system is not well adapted to the practice of the machine shop."

This company's use of the metric system was made in a department separate from other lines of manufacture, and Dr. Sellers explains why its use, when found to be disadvantageous, was not discontinued. He says: "Precisely the same reasons why we cannot change our general system into the metric hold against our giving up the metric system in the departments where it is in use"; and realising the serious disadvantages of this condition, he urges American manufacturers to hold to their present system, and to "encourage the uniformity so desirable, rather than to attempt to make all things new, but in no respect practically better, at so frightful a cost."

Dr. Stratton makes a comparison between the cost of measuring tools in the English and metric systems, and, because he finds that the metric measuring tools are no more expensive than the measuring tools based on the English system, takes the position that the cost of making the change would be negligible. The real cost of making the change is thus ignored. Just the single item of changing the figures on drawings to give the metric equivalents, even if the dimensions were not changed to integral metric sizes, would be an immense task involving the probability of many serious errors. In one case which comes to mind, where the system of numbering parts in the factory was changed for only a part of its product, the cost of changing the drawings and records was found to run into hundreds of pounds. This change, however, was trivial in comparison with what would be involved in changing drawings alone to the equivalents in the metric system; and even after the drawings are changed the expense has just begun.

The workman's handicap in the loss of dexterity when using an unfamiliar system of measurement is an important point to be considered in the adoption of a new system. Workmen who have had years of experience dating back to their apprentice days have become familiar with the inch and its subdivisions. They not only know the fractional sizes of the inch as they do their ABC's, but have worked to thousandths of an inch and other fine measurements until a knowledge of these measurements has become ingrained in their experience.

With regard to changing standards, the writer shows that if we should break away from all present standards and adopt integral metric sizes, with the enormous additional first cost (though we put this great burden on our manufacturers), it would in itself be a serious handicap in competing for world markets, and we would have a much less satisfactory system after the change had been made, besides having sacrificed interchangeability. It is understood that several attempts have been made to adopt metric tapers for the holes in spindles of milling machines, drill presses, etc., but it was found that the standards for these based on the inch have become so fully established that even metric countries use them. Millions of gears are being cut every year, and are made interchangeable on the basis of the inch. A new gear can be cut to replace a worn or broken one, or to add to a set already in use in a distant part of the country, even if the mating gear were made many years ago. The cutters for milling these gears are made in sets, and each shop adds to its stock as required. The introduction of the metric system would mean starting at the beginning, and accumulating a new set of cutters; and a century would not see the end of the confusion and expense which might be caused by such a change.

In order to maintain the interchangeability which we now have, it would be necessary, in addition to our present set of cutters, to have a set with the holes based on the inch to fit our present arbours, but with the pitch of the cutter made to the metric or module system; besides this, it would be necessary to have a set fully in the metric system, including the hole; and to be complete, another set would have metric holes in the cutters and be of diametral pitch based on the inch, so that our present style gears could be cut in the new machine. It might be said that this would make plenty of

business for the makers of gear-cutters, but it would be a serious burden for the users, there being not only the cost of cutters, but also the danger of mistakes, delay, and annoyance, and there would be no advantage in any respect whatever over our present system, either in making calculations or doing the work.

Few manufacturers make their product through all stages from the raw material, and each is dependent on other manufacturers for supplying many of the partly finished details, such as chucks, transmission chain, finished shafting, grinding wheels, etc., made ready to go on machines built otherwise by them; and any change that did not take effect simultaneously in all these co-related lines would lead to misfits, delay, and annoyance. Even if these were avoided, it would require the doubling up of stock. This is illustrated by the use of grinding wheels. Standards for the holes in grinding wheels, where such a large stock must be carried to meet the needs, not only of different shapes, but also of varying grains and grades, would be sacrificed.

Other examples may be found in the diameters of shanks which fit the holes in screw machine turrets and in the width of standard T-slots in which many fixtures and tools fit interchangeably. The report says, "Where a size is not most efficient, it should be changed," here again showing lack of appreciation of the question involved, *i.e.*, the question of standards. Any one of the metric screw thread standards may be fully as efficient as the existing standard; and a metric width of T-slot may be as efficient as our present standard, but it is the breaking away from the standard which causes the trouble, and not the question of efficiency.

At the Brown & Sharpe works there are between five and six thousand different kinds of screws, studs, &c., carried in stock, representing many millions of parts constantly on hand. These are used interchangeably throughout the various lines of manufacture and for repairs to machines made in some cases generations ago. It is not evident how a change in these can be effected "simply" and "easily" and in "a short time, with small expense," as so glibly pointed out by pro-metric advocates, yet this is but a drop in the bucket compared with what we would have to go through if the change were to be made. Here again, the suggestion to use metric equivalents instead of really changing the sizes would be absurd, especially in the light of the pro-metric argument that a change to that system would simplify our work.

The loss of uniformity between nations now using the inch as standard is the last one of the objections which Dr. Stratton so completely sweeps out of the way. This objection is the one dealing with the uniformity which we now have with all other English-speaking people, as well as with great nations that are not English-speaking—uniformity which would be lost if we should abandon our present system. He points out that because there are now some differences in weights and measures among these nations, it is not important to try to keep such uniformity as there is. Any mechanic who stops to think will realise what practically complete uniformity there now is among the English-speaking nations in matters pertaining to the mechanical trade. The difference in screw threads is almost the one exception, and even here both systems are expressed in terms of the inch, and their relation is readily understood.

One statement of Dr. Stratton's is very true, to the effect that "in using the metric system to promote the export trade with metric countries, common sense should take the practical turn of deciding how far its use is profitable. It is believed that our manufacturers and engineers are quite as competent to apply the test of common sense in this matter as theorists and legislators, and that they have been, and will continue doing so, as occasion demands, without the need of meddling legislation. After we had been all through this great upheaval, what would we have to show for it? For the mechanical trades, and for use in the shops, we would not have in the metric system as convenient a system as we now have. The millimetre, the unit generally used in the mechanical trades where the metric system is in use, is so small that it must usually be expressed in many figures. The reason for its use to the exclusion of other units is to avoid confusion in the use of decimal points that would arise in using centimetres, decimetres, &c., and also to avoid the use of a multiplicity of units; so that the lesser of two evils is chosen. Even when compared with our fractional sizes, which may sometimes use nearly as many figures, the metric sizes are not as easily carried in mind. Thus, 384 millimetres is not as easily carried in the mind as 9¾ inches, while 354 millimetres, or even 350 millimetres, would be much harder to remember than 9 inches.

There is no unit in the metric system as convenient as the inch, and there are no subdivisions of the metric unit as convenient for use as hundredths and thousandths of an inch, to say nothing of the fractional sizes, quarters, eighths, sixteenths, &c., so familiar to every mechanic. Another advantage of our present system is that it is adapted for either binary or decimal division. This is a convenience to the draughtsman who, using binary divisions when scaling his drawing down, can make it one-half, one-quarter, or one-eighth size, according to the requirements—a convenience lacking in the metric system—and by using decimal divisions and multiples of the inch when it suits his needs, the draughtsman has a full decimal system, with all the advantages in calculations, &c., claimed for the metric system.

A number of years ago our contemporary said editorially, in corroboration of this view: "So far as the use of the metric system in the machine shop is concerned, we believe it is not, and never can be, as convenient as the English system. The inch subdivided into one-half, one-quarter, one-eighth, &c., is an extremely convenient unit for proportioning machine parts, and when divided into a thousand parts, fulfils all requirements for the most delicate and accurate work."

MR. R. A. CHATTOCK ON INDUSTRIAL RESEARCH, LABOUR AND POWER SUPPLY

Mr. R. A. CHATTOCK'S Presidential Address to the Birmingham Association of Mechanical Engineers on October 7 took the form of a rapid survey of the present position of affairs in the engineering industry and the possibilities of the future. To a large extent it covered points which are just now receiving considerable attention in all quarters, and have been referred to already in our columns. Whilst it will take some time for existing works with their large equipments for war purposes to adapt themselves to production in other channels, it is not thought that the disorganisation will be of any great duration, because it is evident on all sides that it is the intention of the British manufacturer to develop the trade of the country on much better lines than has hitherto been the case. Competition may be eliminated as far as enemy alien countries are concerned, but it will probably be very acute with neutral and friendly alien countries. The need for developing business upon really scientific lines, therefore, was of the utmost importance to British manufacturers. Scientific research is very essential but very expensive, and unless manufacturers are working on a large scale it would be difficult to meet the expense entailed. In such cases groups of manufacturers should combine to carry out research work. In this way central research laboratories could be established, each one dealing with some special branch of industry. Most likely these laboratories would have to be placed under Government control, but they should be maintained by the firms interested in the results to be obtained from them, possibly by some form of annual contribution proportionate to the turnover of each firm. Financial assistance from the Government was rather to be deprecated, because those who benefited should be asked to pay, and pay liberally, for what was done in their interests.

On the question of labour Mr. Chattock does not think that women, as a general rule, will be anxious to continue, when normal times return, many of the forms of employment in which they are now engaged. Young women who have entered works have already expressed their desire to leave and go back to their own occupations, but owing to the rule in controlled undertakings that employees who leave without permission cannot enter other employment within a period of six weeks, they are prevented from doing this. As regards the relations between capital and labour generally, Mr. Chattock is an advocate of letting men earn high wages with the condition that any suggestion of trade union restriction should be removed. The maximum possible output is required.

The question of coal supplies, the possibilities of economy by gasifying coal, and the distribution of electric power throughout the country on a scale at present not approached, was dealt with at some length, but most of the information given has already been published in our columns. It was largely covered by the discussion at the British Association on Fuel Economy (ELECTRICAL ENGINEERING, September 14, p. 350), in which Mr. Chattock himself took part.

In all probability further research work on the subject of distillation of coal will produce even better results than those now obtained. So far these results point to the necessity for utilising the heat units in the coke or other fuel produced as well as in the gas, otherwise there would probably be difficulty in disposing of all the fuel on the outside market. A scheme of this kind would occupy an enormously greater area of ground than the ordinary electric power station at present, but the production of electrical energy in such a way would be carried on at a cost far below what obtains at present, and would make it possible for all users of coal to economically use electrical energy instead. Owing, however, to our conservative nature it is very doubtful whether such a change could be brought about quickly enough to justify the erection of the large super-stations involved without some special steps being taken for the purpose. The very slow

development of the electric supply industry in the past in this country did not hold out much hope of any actual progress being made by natural development, and in order that the public might obtain quickly the benefits that would be afforded by such a scheme some form of compulsion should be exercised. Perhaps the best form would be a tax on all who used coal in an uneconomical manner. Such a tax could be utilised for financing the large electric power scheme until it became self-supporting. In making this suggestion it was anticipated that there would be very serious opposition from many existing interests. It was obviously impossible, however, to inaugurate such a change without interfering to perhaps a large extent with those interests, but if the great benefits to be derived from it were proved by searching inquiry to be obtainable, then the Government ought to take the matter up and deal with it in the national interest.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

ANSWER TO No. 1,512.

A modern 60-b.h.p., 3-phase, 50-cycle induction motor, 420 volts, 480 r.p.m., with wound rotor, drives with belt a Bailey's single-stage double-acting air compressor, whose capacity is 400 cubic ft. per minute at 35 lb. per square inch, running at 160 r.p.m. Cylinder, 375 m/m.; dia. stroke, 350 m/m.; pulley, 60" dia.; motor pulley, 20" dia. There is an automatic valve which stops the motor at 40 lb., and when this pressure drops to 35 lb. it should start again. The valve is working well, but the motor refuses to start, although it takes 120 amps. from the line. If this pressure is dropped to 25 lb. it will start. Why does the motor refuse to start?—AIR.

The first award (10s.) is given to "FLASH" for the following reply:—

From the particulars given in the question the starting torque required to compress the air alone to 35 lbs. per sq. in. is approximately

$$\frac{171 \times 1{\cdot}15 \times 35 \times 2 \times 160}{33{\cdot}000} = 67 \text{ h.p., referred to full load speed.}$$

This figure ignores any leakage and the power required to move the mechanical parts or efficiency. Usually a flywheel is fitted to air compressors, although "Air" does not make any mention of this, but the 60 in. pulley will, to a certain extent, act as a flywheel. Further, the belt will require a good torque to start it; if it is a long drive by its weight, and if a short drive by its tautness. Taking these various items into consideration, a considerable margin has to be allowed above the h.p. given, and the following shows to what extent this margin should apparently be.

The torque developed by the motor when taking 120 amps. from the line would be:

$$\frac{120 \times 420 \times \sqrt{3} \times 0{\cdot}8 \times 0{\cdot}8}{746} = 75 \text{ h.p. referred to synchronous speed.}$$

(Assuming a power factor and efficiency of 0·8 each, which would be the very best one would expect from a wound rotor motor of this output.) With this torque the motor will start against a pressure of 25 lbs., and from the above formula this offers a resistance of 48 h.p.

It will be seen therefore that a starting torque of 55 per cent. above the full-load torque will be required to start the compressor against 35 lbs. per sq. in. This is a reasonable amount, and is usually included in the specifications of a compressor motor. To start the motor against 35 lbs. per sq. in. a line current of something of the order of 175 amps. will be required, and as the full-load current is 95 amps. approx., the motor should be easily capable of withstanding this increased current for the starting period, provided the rotor starter is suitable. The overload starting capacity is required to overcome the pressure behind the stationary piston, and the initial resistance offered by the driving belt, pulley, and stiff bearings. Once these parts are put into motion, the resistance offered is very considerably decreased. To overcome the pressure behind the piston, a by-pass is usually adopted, which is closed after running up to speed. It would appear from the above figures that a 60 h.p. motor was rather on the small side, but it must be remembered that at starting the full pressure of 35 lbs. is offered, whereas in working out the running h.p. required, the average pressure throughout the stroke has to be taken, thus considerably reducing the h.p.

The second award (5s.) is made to "W. H.," who writes as follows:—

The reason the motor will not start the air-compressor against 35 lbs. per sq. in. pressure is that the motor does not develop sufficient starting torque. It is well known that an air-compressor requires a very high torque for starting, especially under the conditions existing in this case, *i.e.*, with the relief valve closed. It is usual when designing motors for air-compressor drive to allow for two to two and a half times full-load torque at starting. The motor in question will take about 76 amps. at full load, so that 120 amps. at starting would give an initial torque of about 1·3 times the full-load running torque.

$$\therefore \text{Starting torque} = 1{\cdot}3 \times \frac{5250 \times 60}{480} \text{ ft. lbs.} = 852 \text{ ft. lbs.}$$

This would give 2,556 ft. lbs. torque at the compressor shaft, the pulley ratio being three to one (neglecting friction, &c.). It can easily be shown that this torque is insufficient to overcome the back pressure on the piston operating against 35 lbs. per sq. in.

Stroke = 350 m/m. = 1·15 ft. $\therefore$ crank = 0·575 ft.

$$\text{Total back pressure} = 35 \times \frac{375^2 \times {\cdot}7854}{25{\cdot}4^2} = 6{,}000 \text{ lbs.}$$

Resisting torque due to back pressure = 6,000 × ·575 = 3,450 ft. lbs.

It will be seen from the above figures that in any case the torque developed by the motor is insufficient to overcome the back pressure. The friction, &c., will, of course, increase the starting torque required.

Assuming now that the valve is arranged to start the motor when the pressure falls to 25 lbs. per sq. in., the back pressure on the piston will be $\frac{25}{35} \times 6{,}000 = 4{,}280$ lbs., and the torque = 2,460 ft. lbs.

It would appear that the back pressure, in addition to the friction, &c., would be greater than the starting torque developed by the motor, but it must be remembered that the air pressure in the cylinder is not always equal to the gauge pressure. If the piston were at the end of the stroke it would require to travel some distance before the pressure rose to the gauge pressure, and it is conceivable that the flywheel would then have sufficient stored energy to overcome the maximum back pressure. The remedy is to alter the starting gear so as to increase the starting current. There is no reason why such a motor should not take at least 190 amps. for starting, and this current should be ample to ensure certain starting.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"The Fan." By C. F. Innes. Revised by W. M. Wallace and F. R. Jolley. 302 pp. 7¼ in. by 5 in. 151 figures. (London: The Technical Publishing Co., Ltd.) Second edition. 8s. 6d. net; abroad 9s. 2d.

[A treatise dealing mathematically with the theory of the action of centrifugal and axial fans and also with the practical design of ventilating machinery.]

Increased Electricity Charges.—Since the charges for electric current were last revised at Gillingham the cost of fuel has risen considerably, and the Electric Light Committee's recommendation that the charge for heating be increased from ¾d. per unit *plus* 10 per cent. to 1d. per unit *plus* 10 per cent., and that an additional 15 per cent. be added to all accounts except contracts, making a total of 25 per cent., has been adopted by the Council. The 10 per cent. extra now charged for meters, radiators, cookers, and other apparatus on hire is to be discontinued. The increase starts from November 1st.

The Bognor Urban District Council is taking objection to the action of the Bognor Gas & Electric Light Co. in charging every consumer a minimum of 20 units per quarter.

"ELECTRICAL ENGINEERING" PATENT RECORD

Specifications Published October 12th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

13,480/15. **Dynamos.** F. A. HEYS (*Neuland Patents, Ltd.*). Dynamo-electric machines on a principle which can be used for speed-reducing clutches, and in a modified form for combined engine starters and car-lighting dynamos, comprising a driven rotor having an induction winding of low resistance, a stator having an induction winding, also of low resistance, arranged in close relation to the rotor winding, and a driving rotating field element, including means for providing a relatively weak magnetic field acting on both the rotor and stator windings, whereby currents of low power factor are produced therein, which co-operate to produce a torque on the driven member exceeding that of the driven member.

13,561/15. **Commutating Field Machines.** G. SCHROEDER. Control of the commutating field of machines with interpoles or compensating winding, in accordance with the voltage drop between the main brush rocker and an auxiliary brush bearing on the commutator in the commutation area. This regulation can either be effected by means of a separate exciter for the commutating pole circuit, or by a Tirrill or similar regulator.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: RAILING & ANGOLD [Arc lamps] 16,694/15.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: WOODHOUSE [Insulators] 12,193/15.

Dynamos, Motors and Transformers: THURY [Regulation of series machines] 13,801/15; SOC. ANON. DES ETABLISSEMENTS L. BLERIOT [Internal combustion engine driven dynamos] 3,817/16.

Heating and Cooking: PARKER [Electric bath blanket] 14,043/15.

Ignition: NEWMAN (*Newman*) [Sparking plugs] 17,330/15.

Switchgear, Fuses, and Fittings: IGRANIC ELECTRIC CO. (*Cutler Hammer Mnf. Co.*) [Controllers] 8,754/16 (*101,525*).

Telephony and Telegraphy: DATZEVITCH [Telephone systems] 12,404/15; MORSE and INDO-EUROPEAN TELEGRAPH CO. [Selective devices] 13,614/15; NAAMLOOZE VERNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ [Thermo telephones] 13,902/15; AUTOMATIC TELEPHONE MANUFACTURING CO. [Telephone systems] 7,100/16 (*100,941*).

Miscellaneous: HANSON and HARRY W. COX & CO. [X-ray tube holders] 15,471/15; FOSTER [Thermo-couple] 17,185/15; CLARKE, CHAPMAN & CO. and R. C. HARRIS [Resistances] 1,724/16 (*101,498*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos: ANSCHUTZ & CO. [Dynamos].

Incandescent Lamps: C. E. J. BRANDT [Incandescent lamps] 13,235/16 (*101,547*).

Ignition: L. BIGNON and J. C. ROUSSET [Magnetos] 13,302/16 (*101,550*).

Instruments: LANDIS et GYR. SOC. ANON. [Prepayment meters] 11,740/16 (*101,535*).

Telephony and Telegraphy: M. I. PUPIN [Electrical tuning] 12,985/16 (*101,540*); M. I. PUPIN and E. H. ARMSTRONG [Electrical wave transmission] 12,986/16 (*101,541*); J. B. NABERES [Ringing magnetos] 13,005 (*101,542*).

Opposition to Grant of Patents

Opposition has been entered to a grant on the following application:—

11,011/15. **Electrodeposition of Tin.** P. MARINO. A system of electrodeposition of a malleable layer of tin, using an electrolyte composed of a tin salt dissolved in hydrochloric acid with the addition of phosphoric acid and other ingredients.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

22,933/02. **Searchlight Mirrors.** C. A. PARSONS and G. G. STONEY. A method of keeping searchlight mirrors cool. A metal plate is attached to the back of the mirror, separated therefrom by a layer of paper, and fitted with radiating ribs or cooled by water circulation.

23,288/02. **A.C. Motors.** G. WINTER and J. F. EICHBERG. Motors with a polyphase stator winding and a rotor with a commutator winding.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: M. LATOUR [Improving commutation of single-phase motors] 14,696/06; A.E.G. [Commutator motors] 14,935/06.

Electrochemistry and Electrometallurgy: C. BINGHAM [Electric furnaces] 14,858/09; F. HOLDEN [Electric clocks] 14,873/09.

Heating and Cooking: H. KRAUTSCHNEIDER [Electrical annealing and tempering] 14,479/04.

Telephony and Telegraphy: G. M. T. PUTZ [Central battery telephones] 14,204/03.

Miscellaneous: F. W. LE TALL (*Cooper-Hewitt Elect. Co.*) [Mercury vapour lamps] 14,166/03 and [Mercury vapour rectifiers] 14,174/03; R. P. HOWGRAVE GRAHAM [Mercury jet interruptor] 14,833/09.

WATER PURIFICATION

VARIOUS subjects connected with water purification for industrial purposes, including filtration, softening, exhaust heating, and oil elimination, are treated of in a sumptuously produced pamphlet embellished by excellent coloured illustrations which has been prepared by the Paterson Engineering Co., Ltd. (India House, Kingsway). In contradistinction, however, to many trade publications attractive to the eye, the literary merit and technical interest of the contents are of an equally high quality. The nature of the impurities to be expected with various descriptions of water supply are indicated, and the most suitable method of removal discussed. Thus, while suspended organic and inorganic impurities can be removed by sedimentation and filtration, and colloidal impurities on the borderland between suspension and solution by coagulation, chemical treatment is necessary for the removal of dissolved organic, inorganic and gaseous impurities. A large number of forms of filter suited to different conditions are described and illustrated, but the most interesting part of the book to the central station engineer will be the section on softening of boiler-feed water. The well-known Paterson cold and hot water softening processes are described, and the final portion deals with the Paterson process of oil elimination from exhaust steam in which coagulation of the oil is effected by the addition of aluminium sulphate.

ARC LAMP CARBONS, BRUSHES, &c.

THE particularly complete list of arc lamp carbons and other carbon products which has been issued by The Electrical Engineering and Equipment Co., Ltd., 109-111, New Oxford Street, W.C., is of special interest at the present time. The arc lamp section commences with full particulars of the "Reflex" brand of cinema carbons, which include a negative carbon with a copper-coated core as well as a cored positive. The cheaper "Etna" cinema carbon has a solid negative, and a third variety, the "Diamant," is specially designed for alternating current. The carbons for ordinary arc lamps include the "Etna" and "Osir," as made for other type lamps, both D.C. and A.C., the "Lungo" for vacuum long burning lamps, the "Uto" brand for miniature enclosed lamps, and a full range of "Diamant" metal core flame carbons for yellow, red, or white flames.

The carbon brush section is equally complete and a valuable compendium of technical information is included. Other carbon products of which details are given in this well-arranged list are battery rods and plates, carbon contacts for circuit breakers, and a variety of other purposes. Furnace electrodes, welding carbons, carbon tubes for chemical works and other purposes, and carbon packing for steam engines and turbines. The company also intimate their willingness to meet any special requirements.

A G.E.C. FRIEND AT THE FRONT

ONE of the consolations to us who are left at home is the receipt of interesting news concerning our old friends in khaki. We hear of promotions, transfers, and also, alas, casualties. As far as the electrical trade has been concerned, items of the first two classes have, luckily, been far more numerous than the last.

Most of us in the electro-journalistic sphere have been familiar with the personality of Lieut. A. R. Courtenay, until recently acting-manager of the Publicity Department of the General Electric Co., Ltd. We were pleased to hear that this officer has now been promoted to a full lieutenant, and he has signalised the occasion by sending a new photograph, which we reproduce on this page. Lieut. Courtenay has had nearly nine months' service in Egypt and Salonika. He was invalided home with dysentery, but happily he is now in good health once more.

Lieut. A. R. Courtenay.

LOCAL NOTES

Keighley: *Extension Rejection.*—A recommendation of the Electricity Committee that a loan of £2,000 for the purpose of laying an extra high tension cable in certain streets should be applied for was rejected at the last meeting of the Corporation. When the matter was under discussion strong feelings were expressed that this expenditure should not be incurred at the present time, especially as no estimate of revenue from it has been put in. The reason for the recommendation was that the cable would complete a circuit in order that the extra current required for munition work might be adequately met, and safety against breakdown provided for.

Liverpool: *Street Lighting.*—It has been reported to the Tramways and Electric Power and Lighting Committee that the saving made since August, 1915, by reason of the curtailment of street lighting amounts to £14,407.

London: *L.C.C. Electrical Employees' Wages.*—Applications having been received from the charge engineers in the tramway sub-stations for a war bonus of 4s. per week and from the wiremen's mates at the Greenwich generating station for an increase of 2d. per hour, the Highways Committee have referred the matter to the Electrical Conciliation Board.

Sunderland: *Extension Scheme.*—Reference was made at the last meeting of the Corporation to the proposed extension scheme estimated to cost £45,246, mentioned on page 381 of our issue of October 5th. Alderman Bruce, Chairman of the Electric Lighting Committee, said that from the information given by the electrical engineer the committee was absolutely convinced that the time had come when it was necessary to make extensions at the Hylton Road Works. Last year it took thirty-three weeks to repair one of the turbines which had broken down, and during that time the reciprocating engine had to be used, involving an increase of £3,000 in the working costs. Whilst this demonstrated the economy of modern plant it was not the ground upon which the present extension scheme was really based. The new plant was necessary to meet the industrial demands of the town. As to any fear that the committee would spend money unnecessarily, the Corporation could rest assured that the Treasury and the Ministry of Munitions would take care of that. The scheme, which provides for an additional 7,500 kilowatts of plant capacity, received the sanction of the Corporation.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Chesterfield.—The Local Government Board, which has been in communication with the Ministry of Munitions on the matter, has notified the Corporation that it is prepared to sanction loans amounting to £20,600 for extensions at the power house. The Board enquired as to whether the air filter is to be a wet or dry one.

Liverpool.—A scheme for additional generating plant will shortly come before the City Council.

Norwich.—A new sub-station is to be built.

Miscellaneous

Australia.—The specification and tender forms in connection with tenders required by the Deputy Postmaster-General for telephone parts may be consulted at 73 Basinghall Street, E.C. The preliminary deposit may be paid at the offices of the High Commissioner in London for the Commonwealth of Australia, 72 Victoria Street, S.W.

London: *L.C.C.*—The London County Council Asylums Department requires a supply of electric lamps. Clerk, Asylums and Mental Deficiency Committee, 2, Savoy Hill, Victoria Embankment, W.C. October 24th.

Manchester.—The Tramways Committee requires a supply of hard drawn copper trolley wire. Chairman, Tramways Committee, October 24th.

South Africa.—A copy of the specification and tender form in connection with tenders required by the South African Railways Administration for its electric lamp requirements during 1917 may be seen at 73, Basinghall Street, E.C. Tenders to the Tender Board, South African Railways, Johannesburg, by November 13th.

APPOINTMENTS AND PERSONAL NOTES

Mr. J. B. Morgan, Borough Electrical Engineer, Horsham, has resigned on receiving the appointment of works manager at the Horsham Engineering Works. A successor is to be advertised for at a commencing salary of £220 per annum.

Mr. D. McLennan, Borough Electrical Engineer at Oban, has resigned.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Companies Struck Off Register.—The following have been struck off the register of joint stock companies: British Tungsten Lamp Co.; Doncaster Electrical Co.; Electric Safety Boiler Cleaner; Ernest Scott & Mountain; Kevan Electric Co.; and Marples Leach & Co.

Callender's Cable & Construction Co.—An interim dividend of 5s. per share, being at the rate of 10 per cent. per annum, less income tax, is recommended.

The Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £142 to £144 (last week £141 to £143).

TRADES DIRECTORY OF
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(One Free Entry is given to every Advertiser. Entries under additional headings, 6d. per insertion.)

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Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
Fletcher (H. J.) & Co., Bridge Works, New North Rd., London, N.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Guilbert-Martin, 9, Edmund Place, E.C.
Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
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Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sloog, H., 51, Anson Rd., London, N.W.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

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Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool.
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

HEATING AND COOKING APPARATUS.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
The Bastian Electric Co., Ltd., 185, Wardour St., W.C.

INSTRUMENTS.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C.

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Phœnix House, King William St., E.C.

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Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
"Lamlok," 18, Ranelagh Gdns., Hammersmith, W.
London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39 Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.

LAMPS (Incandescent)—*contd.*
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

MECHANICAL STOKERS.
Underfeed Stoker Co., Ltd., Coventry House, South Place, E.C.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

MOTORS AND DYNAMOS.
British Thomson-Houston Co.. Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Langdon-Davies Motor Co., 110, Cannon St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PACKING.
Dermatine Co., Ltd., Neate St., London, S.E.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons. Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

RUBBER GLOVES.
Ingram (J. G.) & Son, Hackney Wick, N.E.
Moseley (D.) & Sons, Ltd., Ardwick, Manchester.

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Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk St., W.C.
Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
United States Metallic Packing Co., Ltd., Bradford.

SWITCHGEAR.
British Thomson-Houston Co., Ltd., Rugby.
Dorman & Smith, Ltd., Ordsal Electrical Works, Salford.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Electric Control, Ltd., 177, Reid St., Bridgeton, Glasgow.
Ellison (George), Warstone Lane, Birmingham.
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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Igranic Electric Co., Ltd., 147, Queen Victoria St., E.C.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.

TECHNICAL BOOKS.
Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
Constable (Archibald) & Co., Ltd., 10, Orange St., Haymarket, W.
Crosby Lockwood & Son, 7, Stationers' Hall Court, E.C.
Macmillan & Co., Ltd., St. Martin's Street, W.C.

TELEPHONES.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Graham (Alfred) & Co., St. Andrew's Works, Crofton Park, S.E.
Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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SUMMARY

FURTHER information is given with regard to overhead transmission line wayleaves (p. 404).

WE are able to publish some interesting results of tests of condensing plant at the new power-house of the London & South-Western Railway (p. 405).

A PAPER read by Mr. F. H. Taylor before the Junior Institution of Engineers gives a general sketch of the subject of illumination of industrial premises (p. 406).

A DETAILED report has been presented to the Edinburgh Corporation recommending the adoption of the overhead trolley system in substitution for the present cable car system (p. 407).

AN interesting report has been prepared by Mr. S. L. Pearce, Chief Electrical Engineer to the Manchester Corporation, in which he shows, as a result of tests, that a three-ton electric vehicle is able to do the work of 2½ horse lorries engaged upon Corporation cartage work, and that a saving of £40 15s. was made in the cost of carting for the first five months of 1916 (p. 408).

AMONG the subjects of specifications published at the Patent Office last Thursday were regulation of series machines, arc lamps for searchlights, and motor control (p. 409).

A QUESTION is propounded in our "Questions and Answers" column dealing with the arrangement of a battery and booster installation (p. 407).

WE give an outline of the programmes for the 1916–17 session of the various engineering societies (p. 410).

IN his Presidential Address to the Association of Engineers-in-Charge, Mr. Frank Bailey dwelt on some questions connected with the position of the engineering industries of this country after the war (p. 410).

THE question of the law as regards payments under street lighting contracts which cannot be carried out owing to the lighting restrictions has been brought to the attention of the Local Government Board.—The recent serious interruptions in the tramway supply at Birmingham are attributed to the abnormal load upon the plant and the difficulty of effecting proper maintenance in consequence (p. 411).

PARTICULARS are given of a number of contracts in New Zealand and South Africa; a 400-point wiring job is open at Wolverhampton; and a supply of electrical materials is required at Glasgow (p. 412).

THE report of Dick Kerr & Co., which recommends a 6 per cent. dividend on the ordinary shares, the first for five years, states that the Company has acquired the control of Messrs. Willans & Robinson (p. 412).

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE, S.W.
ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Platoon Commander C. H. C. Bond.

Next for Duty.—Platoon Commander Hughes Hallett.

Appointments.—Corporals B. F. Bristow and D. R. Newlands to be Section Commanders (dated Oct. 14).

Monday, Oct. 30th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill. 6.25 to 8.0

Tuesday, Oct. 31st.—School of Arms, 6 to 7. Lecture, 7.15. "The Duties of the N.C.O.," by Co-Comdr. Hynem. Range Practice.

Wednesday, Nov. 1st.—Instructional Class. 6.15. Platoon Drill, Platoon No. 1. Range Practice.

Thursday, Nov. 2nd.—Platoon Drill, Platoon Nos. 5 and 6. Range Practice. Lecture by Medical Officer. 6.0. "Marching and the Care of the Feet."

Friday, Nov. 3rd.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill. 6.25 to 8.25.

Saturday, Nov. 4th.—N.C.O.'s Class. 2.30. Coy.-Comdr. Fleming.

Sunday, Nov. 5th.—Entrenching at Otford. Parade Victoria (S.E. & C.Ry.) Booking Office, 8.45 a.m. Uniform, haversacks, water bottles. Mid-day ration to be carried. Railway vouchers will be provided.

Musketry.—For all Companies see Notice and Tables A and B at Headquarters.

Note.—Unless otherwise indicated all drills, etc., will take place at Headquarters.

NATIONAL ELECTRIC POWER SUPPLY

THE suggestion by the Joint Committee of the I.M.E.A. and the Electric Power Companies to appoint District Committees on the lines mentioned on page 384 of our issue for October 12th, with a view to arranging for complete linking-up schemes throughout the country, is being well received by the various electric supply authorities. Mr. T. Roles, Chief Electrical Engineer at Bradford, has been requested by his Committee to attend the preliminary meeting of the Yorkshire Committee; Mr. J. K. Brydges, Chief Electrical Engineer at Eastbourne, has received similar instructions so far as the Committee to deal with his part of the country is concerned; Mr. W. J. Wood, Chief Electrical Engineer at Bolton, has reported to his Committee upon the position of Bolton as regards the Lancashire scheme, already referred to in our columns, and consideration of this has been deferred until the next meeting; Mr. L. W. Woodman, Borough Electrical Engineer at Dover, is to attend the meeting of the Committee for his area, and the Lancashire report which has been sent to the Whitehaven Council is under consideration there, although the Electricity Committee does not regard itself as being in a position to take full advantage of the proposal. The matter, of course, has been under consideration all over the country, and the above are only a few instances where definite action has been taken.

Electricity Supply at Glasgow: Serious Position.—Mr. W. W. Lackie, Chief Electrical Engineer to the Glasgow Corporation, has reported upon the serious position which is likely to arise in the near future owing to the shortage of plant and the ever-increasing demands upon the undertaking. The Corporation a short while ago decided to proceed only with contracts already placed for the new power station at Dalmarnock, but Mr. Lackie now expresses the opinion that the time has arrived when the Committee must instruct him either to stop connecting new consumers; to connect them only on an understanding that supply will be discontinued to them during the winter months, or to proceed with a portion of the new generating station. A special committee which was appointed to go into the question has recommended that the latter course be followed.

Arrangements for the Week.—To-day (*Thursday*), *Oct. 26th*,—North-East Coast Institution of Engineers and Shipbuilders, Annual general meeting, Mining Institute, Newcastle-on-Tyne. "Works Organisation," by Messrs. Parsons, Orde, and Tweddle. 7.30 p.m.

Friday, Oct. 27th.—North-East Coast Institution of Engineers and Shipbuilders. Annual general meeting continued. 7.30 p.m.

Physical Society, Imperial College of Science, South Kensington, S.W. (1) "The Determination of the Saturation Values for Magnetism of Ferromagnetic Metals, Compounds, and Alloys by Means of the Kerr Effect," by S. G. Barker. (2) "The Influence of the Time Element on the Resistance of a Solid Rectifying Contract," by D. Owen. 5 p.m.

Tuesday, Oct. 31st.—Association of Supervising Electricians, St. Bride Institute, Bride Lane, Ludgate Circus, E.C. "Electric Heating and Cooking," by A. F. Berry. 7.15 p.m.

OVERHEAD TRANSMISSION LINE WAYLEAVES

WE conclude below the information that has come into our hands on the question of wayleaves. Previous articles on the subject were published in our issues of October 5th and 12th.

One of the weakest points in the powers of some power companies is that the granting of consent for overhead mains over private property is subject to the consent of the local authorities. It seems a little absurd that a large public undertaking should be subjected to the veto of small local authorities to carry overhead mains within its own area over private property, when a private person can do so where he likes with the consent of the owners. It would appear reasonable that they should have the right to prevent high pressure mains crossing the road overhead if they wish it; but unfortunately the very fact that their consent has to be obtained tends to make them think that there is some great danger to be avoided. In cases where the consent is largely obligatory, usually local authorities take it as a matter of course and no complaints are made. In the present case the power company has been fairly lucky with landowners and tenants, and a standard form of printed wayleave has been of considerable assistance.

Most of the trouble in the way of absolute refusal of wayleave has been in the cases of small-holders, and in a number of cases considerable diversions of lines have had to be made to avoid them. In some cases it has been necessary to alter the entire proposed route of four or five miles of mains a number of times to do so. The small-holder, however, will generally accept the standard printed form of agreement when he does consent.

Large landowners, as a rule, are willing to give wayleaves, but in these cases the negotiations are with the lawyer, which generally means a lengthy agreement and a number of impossible clauses which it takes time to eliminate. It is quite common also to have clauses put in which, to a large extent, puts the company at the mercy of the landowners, with the possibility of having their trunk lines cut in two at some very inconvenient moment.

One of the difficulties in this country is the great and rather natural objection to poles in the middle of fields, and the consequence is that with short-span constructions it is difficult to get a straight line or make a really good construction. In cultivated country this tends to the use of long-span constructions to enable poles to be placed in the hedge, and in any case the irregular lines or long spans with special steel structures tend to increase considerably the cost of overhead line constructions.

Large power companies should not be subjected to the mercy of any landowner who puts difficulties in the way of carrying overhead mains any more than a railway company should be prevented in the construction of a railway, providing that the landowner does not suffer any damage to the extent of actual damage or reduced value of his property. It seems only reasonable that power should be compulsorily subject to reasonable compensation, which could be agreed upon before a proper Court. Railway companies are rather inclined to be exorbitant in their charges for wayleaves or work in connection with crossing their lines, no doubt owing to the fact that it is uusal in this country to value all vested interest at a high rate. The Post Office also have most objectionable powers. They are not satisfied with anything which would be, and is considered, safe by any other authorities, but after all sorts of elaborate guarding arrangements are fitted at considerable cost they then proceed to go underground, and an expenditure of £50 or so is not unusual to carry a pair of telephone wires under a power line. Not only do they seem to have the power to ask what they like when power lines cross Post Office wires, but if the power undertaking is there first the Post Office may cross the power wires as many times as they like at the power company's expense.

On the whole, in a rather wild country, not so much difficulty has been experienced in carrying overhead wires as would be the case in more cultivated districts, but it will hardly be practicable to develop overhead mains of great importance in this country until the supply authorities and particularly power companies have compulsory power to carry those mains, subject to the reasonable powers of a Court to prevent these mains being carried in such places as would be really objectionable.

We have in use some 10¾ miles of 6-wire and 28 miles of 3-wire overhead lines, and have on the whole been successful in arranging the wayleaves at a fairly reasonable figure. In a few cases we have been able to secure a 15 years' lease, but as a general rule the wayleave is granted only at the pleasure of the proprietor. This is one of the chief objections to the existing system, and another objection is the time taken to make all the necessary arrangements with the proprietors and tenants. In several cases we have had to make considerable deviations owing to the proprietor refusing to cut down trees on any terms, and we have generally to keep close to fence or hedge lines as it is most difficult to obtain a wayleave for poles through fields.

In the case of one line 5½ miles long we failed to come to terms with one proprietor for a wayleave for 13 poles. Owing to the prohibitive wayleave demanded we decided to lay an underground cable in the public roadway. This necessitated cutting out some 24 poles on adjoining estates and laying 2,100 yards of underground cable in place of 1,500 yards of overhead line. In another similar case where we could not arrange a wayleave for 10 poles (about ¼ mile of route) in about the centre of a 7-mile line, we had to arrange new wayleaves for 2½ miles, the total length of the line being increased by about one half mile.

A department which has some twenty-two miles of overhead transmission line, has found that landowners, tenants, and the Post Office handicap the work of erecting these transmission lines. With regard to the Post Office, it takes an exceedingly long time to obtain permission from the department, notwithstanding they have no telegraph or telephone wires within three miles of the proposed transmission line. It is still more difficult if the proposed transmission line is near to the Post Office wires, and on a number of occasions it has been necessary to run unnecessary underground cable in order to satisfy the Post Office.

In one particular instance the transmission line ran in parallel with a railway, alongside which were Post Office wires. The railway company agreed to the erection of transmission lines on the side of the railway 30 feet clear of their telegraph lines, but the Post Office interfered and insisted on the whole of the line being taken down, 30 feet being considered too near, and imposed a distance 60 feet clear of the railway telegraph lines. The Post Office had but the use of one of these wires, and it was impossible within 30 feet for any of the power wires or poles, should they have broken down, to get in contact with the telegraph wires. Other instances have occurred in which, if the Post Office would give way a little and not keep to such stringent unnecessary regulations, it would have saved a great deal of expense.

As regards landowners, permission in this district has been freely granted. Lord —— point-blank once refused to allow poles to be erected on his property, although the land in question was neither good for agriculture nor grazing, but nothing would induce him to change his mind and another route had to be taken.

As far as the tenants are concerned, the department has continually been "up against" them. No permission can be obtained to go through a field, and, furthermore, the farmers maintain that the damage which would be done to the land in erecting one pole would be in some cases £1 and in other cases £2, and, after all damages have been paid, they wished to impose an annual fee of £1 per pole. This sum has not been agreed to. Electric supply companies and Corporations should have more powers and facilities in erecting transmission lines, and a definite rent per pole should be decided, similar to what the Post Office have. In this particular district the fee for a telegraph pole is 1s. per pole, but there are a few odd cases where an extra sum is charged.

Committee on Non-Ferrous Metals.—The President of the Board of Trade has appointed Sir Gerard Muntz., Bart. (Chairman), Mr. Cecil Lindsay Budd, Mr. Clive Cookson, Mr. C. W. Fielding, Lieutenant-Colonel A. J. Foster, Mr. A. W. Tait, and Mr. A. H. Wiggin, J.P., to be a Committee to consider the position after the war, especially in relation to international competition, of the lead, copper, tin, and such other of the non-ferrous metal trades as may be referred to the Committee, and to report what measures, if any, are necessary or desirable in order to safeguard that position. The secretary of the Committee is Mr. James F. Ronca, to whom all communications relating to the Committee should be addressed at 7, Whitehall Gardens, S.W.

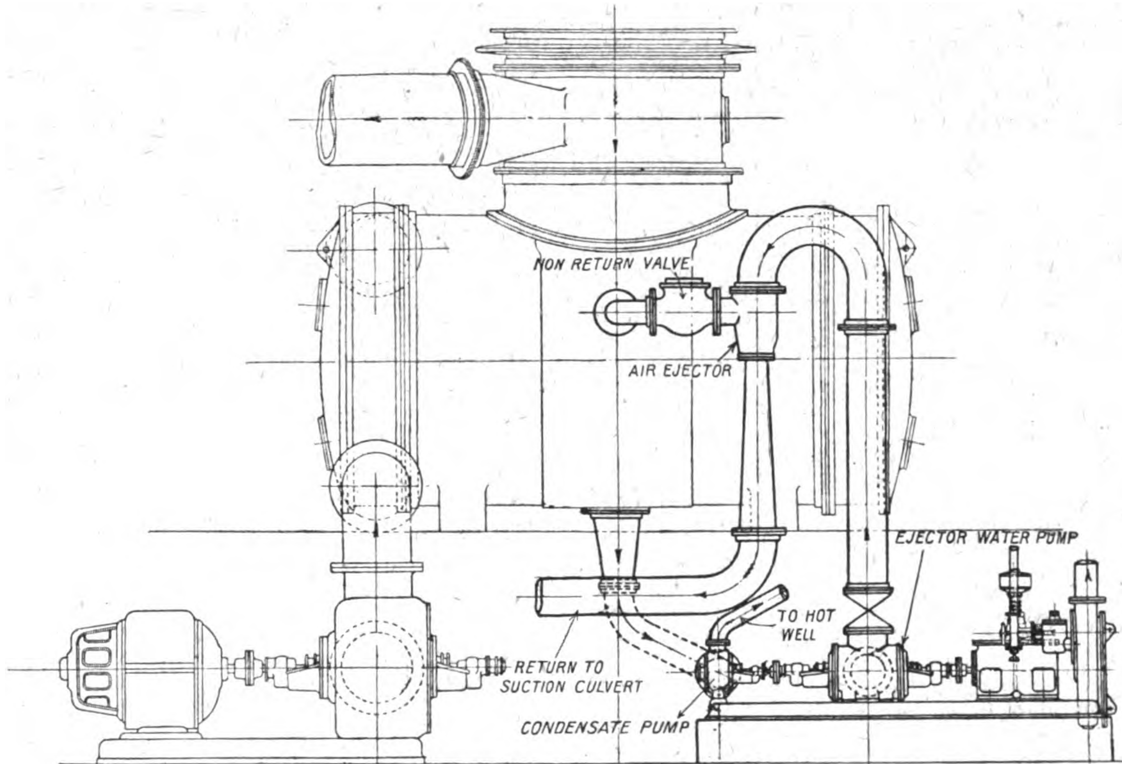
The Marylebone Oerlikon Turbo-tenders.—After about three years' running these turbines have been opened up for examination. No. 11 was found to be in good condition, and the low-pressure wheels of No. 10 were found to be slightly corroded. During the three years these machines have run 27,009 hours out of a possible 50,352 hours, and have generated 56,032,684 units, or 84·06 per cent. of the total units generated. They have cost for repairs £45, and oil £136—very low figures, only amounting to 0·00078d. per unit generated.

TESTS OF CONDENSING PLANT

We have received from Willans and Robinson, Ltd. (Rugby), some interesting figures of test results obtained on one of five surface condensing plants embodying their rotary air pump system and recently installed at the London and South-Western Railway Co.'s Durnsford Road Power Station. The general arrangement of the plant is seen in the accompanying figure. In addition to these five identical condensers the station has two smaller plants of similar design also embodying the Willans rotary air pump system.

The main feature of this system is that the circulating water is passed through an ejector, which is shown on the drawing and which takes the place of the ordinary air pump. A separate condensate pump is provided to withdraw the condensed steam from the surface condenser and to return this to the hot well. An automatic non-return valve is placed between the air ejector and the main condenser body, so as to prevent water being drawn into the condenser in case of failure of the ejector. There are three common forms of application of the system known as the "series," the "shunt" and the "separate pump" types respectively. In the case of the "series" type of plant, the whole body of the circulating water is passed through the air ejector before entering the condenser—that is to say, the circulating pump is designed for the normal quantity of water required by the condenser, but allowance is made in calculating the head for the necessary drop across the air ejector. In the case of the second or "shunt" system the cooling water for the condenser and the ejector water are delivered in parallel and the ejector water is returned to the source of supply or to the circulating water suction. In other words, the circulating pump is designed for the normal head required by the lay-out of the plant with allowance for condenser friction, and the quantity delivered is that needed for the condenser itself, plus the necessary water for the air ejector. The third, or "separate pump" type, of which the L. and S.W. installation is an example differs from the "shunt" system only in that a separate pump is provided for delivering the air ejector water as apart from the main circulating water pump which supplies the condenser in the ordinary way.

In the present installation both the main circulating pump and the ejector pump draw their water by means of a common suction pipe from the main suction culvert, which runs the full length of the engine room. The water coming from the condenser itself is of course heated and passed to the delivery culvert, but the air ejector water is returned to the suction or inlet culvert. It will be noted that in this instance the circulating pump is driven by means of a continuous current motor, whereas the ejector pump and condensate extraction pump are driven by a small steam turbine.



The tests were carried out on August 20, 1916, after the plant had been in service for a considerable period, in the presence of the representatives of the consulting engineers, Messrs. Kennedy and Donkin, and of Mr. Herbert Jones, chief electrical engineer to the London and South-Western Railway Co.

It will be noted from the figures set out in the table below that the vacuum attained is substantially above that guaranteed, and particular attention may be drawn to the very low difference between the circulating water outlet and vacuum temperatures. The makers are to be congratulated on the excellence of the results attained.

Trial number	1.	2.	Guarantees.
Duration of test ...	60 minutes.	60 minutes.	
Load, lbs. of steam per hour	68,176.	68,389	68,000
Vacuum at steam inlet to condenser, corrected to 30 in. barometer	28·73 in.	28·76 in.	28·5 in.
Corresponding steam temperature ...	86·6° F.	86° F.	92° F.
Condensate temperature	82° F.	82·5° F.	87° F.
Difference between condensate and vacuum temperatures ...	4·6° F.	3·5° F.	5° F.
Circulating water inlet temperature ...	58·5° F.	58·5° F.	65° F.
Circulating water outlet temperature ...	80·8° F.	81·1° F.	83° F.
Difference between circulating water outlet and vacuum temperature ...	5·8° F.	4·9° F.	9° F.
Cooling water, gallons per hour	318,000	317,600	396,600

Commercial Intelligence Branch of the Board of Trade.—The Board of Trade announces that with a view to improving the organisation for assisting trade now represented by the Commercial Intelligence Branch of the Board of Trade, it has been decided to amalgamate this Department with the Exhibitions Branch of the Board. Sir William Clark, K.C.S.I., C.M.G., will be Comptroller-General of the combined Department, which in future will be known as the Department of Commercial Intelligence. Mr. Thomas Worthington, who has just retired from the post of Director of the Commercial Intelligence Branch under the age limit, has consented, at the request of the President of the Board of Trade, to assist the new Department in a consultative capacity as Commercial Adviser.

INDUSTRIAL LIGHTING

A PAPER by Mr. F. H. Taylor, read on Wednesday of last week before the Junior Institution of Engineers, gave a general sketch of the subject of illumination of industrial premises, to which an increasing amount of attention is now rightly being paid. He remarked at the outset that overall efficiency or watts per candle-power given out was too often the only point considered in the selection of lamps instead of the total cost per candle-power hour, which, of course, takes into account the first cost of the lamp and its life, as well as the cost of current. In a case within the author's experience it paid to use the old-fashioned carbon filament lamp with its wasteful consumption of 3½ watts per candle-power. This occurred in a factory where not only were more lamps lost by breakage than by ordinary burning out, but the current was supplied by steam-driven generators, the boilers for which were fed entirely on refuse which would otherwise have cost money to cart away.

Hard and fast rules for the lay-out of industrial lighting installations were undesirable, even if possible of general application. It is true, continued the author, that progress is being made in the direction of deciding as to what is a suitable standard or intensity of illumination for various processes and kinds of work, but this is, and will probably remain, as the *minimum* illumination necessary, rather than the average. Lay-out must, therefore, be settled not on this point only, but on due consideration of the many other variable points which will be found to enter into almost every case one meets in practice.

A point one would specially draw attention to in this connection is the need of "general" as well as "local" or "individual" lighting in most, if not all, of the premises which the mechanical and the civil engineer have to deal with.

The "general" lighting should be so arranged that a fairly uniform illumination is produced, say, with an allowable variation between maximum and minimum of 20 to 25 per cent., and where individual lighting is additionally provided the value of the former is considered sufficient if of the nature of about 1·5 foot candles. Compared with the recommendations of the Home Office Committee such a figure will seem luxurious; the recommendations referred to being 0·25 of a foot candle over "working areas" of workrooms (without prejudice to the illumination required for the work itself), and 0·1 of a foot candle in all parts of factories and workshops not included under the above, and where persons are liable to pass.

The author summed up the essentials of satisfactory illumination as follows:—Adequacy; that is to say, the *degree* of illumination produced on the working surface must be sufficient for the work or operation to be properly carried on. On the other hand, over-illumination is quite possible and its effects are naturally harmful. The lighting unit or source of light must be so placed that the light does not strike directly upon the eye of the operator either when he is engaged in his work or when looking horizontally across the workshop or room. This recommendation of the Home Office Committee may be summed up in the words: "Light on the object and not in the eye." Thus "glare," whether produced directly or indirectly, should be avoided. The lighting units should be so placed as to prevent shadows on the work or heavy shadows about those parts of the premises to which the workpeople have access. This does not suggest that an absolutely uniform degree of illumination everywhere is necessary. The opposite is desirable as affording relief by contrast. Constancy, so far as the degree of illumination is concerned, is also necessary. Where the current is supplied from public lighting systems, there is usually little or nothing to complain of in this direction, but where the lighting receives its current from a private plant on the premises, constancy of illumination is by no means always prevalent.

With regard to the effect of colour, the author considered that we inclined naturally to light associated with the red end of the spectrum, and remarked that the effect of mental depression on remaining under bluish light for any length of time in some persons is most noticeable. Mercury vapour lamps when used for general lighting have been noticed to give different results with different people, where all other conditions were equal; one man, for example, insisting on the addition of an ordinary glow-lamp in order to carry on his work, whereas other workers considered this quite unnecessary.

The controversy between direct and indirect lighting was not gone into at any length in the paper. Obviously, continued the author, for either direct or indirect lighting, the most important item is the reflector, or, as it is more often called, the "shade." Until recent years, for incandescent lighting, nothing else scarcely was used but the shallow, conical enamelled iron or opal glass reflector. Custom clung very tenaciously to this, probably on account of cheapness. For years, imported from "another" country, the best one could say of this type of shade was that it was badly made. As a shade, it shaded very little else than the ceiling. In combination with a carbon filament lamp it was bad enough, but with a metal filament lamp, with its higher intrinsic brilliancy and extended length of bulb, the evil effects of an unscreened light became infinitely worse. Happily with the war a limit was put on the supply of these goods, with the result that properly designed reflectors in glass or steel are more open to appreciation in spite of the higher first cost. One refers particularly to the prismatic glass reflectors of the "Holophane" type and also to the pressed steel reflectors of the "Benjamin" pattern, intended more particularly for factory service. By the choice of a reflector either of the "extensive," "intensive," or "focussing" type, and with the spacing distance arranged with regard to height, it is easily possible to obtain any desired illumination, and with the source of light well screened from the eye.

With the use of tungsten lamps ventilation of the reflector or lamp-fitting becomes necessary owing to the high temperature of the filament, if the lamp is to last any length of time, and with ½ watt units the need in this direction becomes very greatly increased.

Passing on to the subject of maintenance, the author emphasised the necessity for more attention than is usually paid to the cleaning of lamps, reflectors, etc., if the standard of illumination is to be kept up.

With regard to switch control, increased attention should be paid to a more liberal use of switches, better location, and the use of two or three point control.

The best of lamp switches, he continued, are not expensive to buy, and by providing an ample number, in proportion to the lamps installed, every facility is given for exercising economy. For individual or local lighting, the switches should be as conveniently near as possible to the lamps controlled. These can be further controlled by a master-switch or switches placed conveniently for use by the shop-foreman, who would also control the "general lighting." In some cases it is a great convenience to be able to control one or more lights from two or more positions, by what is commonly known as 2-way and also "intermediate" switching. Lamps switched near doorways are an example. Economy commonly follows the convenience. Switches in factories commonly suffer from lack of adequate mechanical protection. Where conduit wiring is adopted, iron switch boxes which absolutely protect the switch and only leave the knob projecting are to be preferred. Owing to its light construction, the ordinary "5-ampere" switch, even if only loaded to less than half this amount is, at modern voltages, liable to rapid wear.

For factory use the screwed tube wiring system was very largely used, as affording a good mechanical job as well as a sound one electrically. From a fire risk point of view it was beyond question.

It should preferably be kept clear of all other metal work, be made electrically and mechanically continuous throughout, and properly earthed at least at one point. Inattention to earthing of metal work, on the one hand, and to the careful insulation of the wiring and electrical conductors generally, on the other, might often lead to very unexpected faults in the lighting, to say nothing of the risk of personal shock or fire.

With a view to maintaining efficiency in the lighting, attention should be paid to the following details in the circuit wiring:—"General" lighting to be circuited separately from the local lighting, and, where possible, alternate units to form a circuit; a more liberal allowance in the number of circuits or "ways" per distribution board should be adopted, thus ensuring a minimum of the lighting units being out of action in the event of a circuit fuse blowing. Motor circuits to be entirely distinct from those supplying lighting, both as regards wiring and the fusing at main or sub-main distributing boards.

Increased Electricity Charges.—The Huddersfield Corporation has decided to increase the electricity charges by a further 12½ per cent. as from the December meter readings.—A scale of increased charges has also been approved by the Weymouth Corporation, the justification for this being that there was last year a net loss on the woking of the electricity undertaking of £2,402.

The late Sir William Ramsay.—Steps are being taken to raise a memorial to the late Sir William Ramsay. A meeting will be held at University College on October 31st with this object in view.

THE EDINBURGH CABLE TRAMS

Trolley System Recommended

WE have mentioned on various occasions recently certain facts in connection with the Edinburgh cable tramway system and the efforts of the Corporation to acquire the undertaking before the expiry of the lease in the ordinary course in 1919. Already one line, owned by the Corporation and leased to the Edinburgh Tramways Co., is worked electrically, and there never has been any doubt but that the Corporation when it came into full possession would, in spite of the excellent manner in which the cable system has been maintained, substitute for it some system of electric traction.

There has now been issued a report by Messrs. J. Brodie, the City Engineer; J. B. Hamilton, general manager of the Leeds tramways; and A. Horsburgh Campbell, the Burgh Engineer. These gentlemen state :—

(1) That it is not advisable to continue the cable tramway system for the city or for any part of the city after the expiry of the lease in 1919.

(2) That it is practicable to arrange for a system of traction other than the cable being installed so as to be operated on the expiry of the present lease.

(3) That the only alternative system of traction which can be made available at June, 1919, and which can be confidently advised, is the electric overhead system.

(4) That, independent of the existing tramway conditions of the city, the electric overhead system of traction offers the best, most reliable, convenient and economical solution of the transit requirements of the city and suburbs.

(5) That in the detailed treatment of the overhead equipment, special care should and can be given to the preservation of the amenities of the city.

(6) That as regards Princes Street, whilst temporarily it must be equipped with the overhead system (unless diverted), the conduit system may be constructed subsequently—should the Corporation so desire.

(7) That it is desirable that facilities for through-running between the tramways of the city and the neighbouring tramway undertakings should be provided.

(8) That, keeping in view the proper development of the undertaking in relation to future extensions, the tramway system should be extended by a total route length of 8¾ miles.

(9) That the influence of the motor 'bus traffic upon the future of street transit in the city should be considered by the Committee with a view to co-ordination and the avoidance of waste.

(10) Power should preferably be obtained from the Corporation's new power station at Portobello.

(11) It will be necessary at an early date to initiate arrangements with respect to the provision of suitable rolling stock and additional depôt accommodation.

(12) If the Corporation decides to continue the cable system after the expiry of lease it will be necessary :—(*a*) To initiate arrangements for the provision of new rolling stock (suitable for conversion and adaptation to the other form of traction later.). (*b*) To provide additional depôt accommodation. (*c*) To restrict the programme of extensions to routes capable of being worked by "self-propelled" cars and running along and over the existing cable lines. And (*d*) to arrange for the cables which will be doing duty at the close of the lease being available thereafter.

(13) That it is desirable in the event either (1) of electric being installed or (2) of the cable being continued, that an electric battery tramcar and a "self-propelled" tramcar should be acquired with a view to running in series with other cars, provided arrangements can be made for their trial.

Very detailed estimates of cost are given of a number of alternative proposals, but, taking the overhead system throughout with the suggested 8¾ miles extensions, the revenue for the year 1919-20 is given at £356,908, the working expenses at £217,007, capital expenditure £936,500 and capital charges £73,663. A financial result of £66,236 profit is anticipated.

It is pointed out that the installation of the overhead system during the currency of the lease can be accomplished by the adoption of the twin overhead wire, just as in railless traction at Leeds and Bradford and as adopted by the London County Council in one of their latest extensions from Woolwich to Eltham. The twin wire was required for the purpose of completing the electric circuit pending the "bonding" of the rails, which would be done after the lease had expired. When the "bonding" was carried out the twin wire would be taken down and the single wire for each track left in position. The wires and their supports might be erected during the period intervening between now and 1919 without interfering with the cable car service.

The report also goes into the value of the cable system as a set-off against the cost of the new electric system. The likely outstanding debt is regarded as small compared with other tramway undertakings which have been acquired by municipalities.

"ANTI-ZEPP" SHADES

THE lighting regulations, which are now being enforced with considerable rigour, have given rise to a demand for shades which will effectually meet the conditions without shutting off more light than is absolutely necessary. In order to meet this demand The General Electric Co., Ltd., are putting on the market a series of cardboard lampshades with special features which commend them for general use. These shades, instead of being fixed to the lampholder, are held by cords which are tied to the flexible wire above the lamp at the height necessary to screen the rays from the window. Different sizes and shapes of shade are available, so that their adjustability to all conditions is complete. One form is made with a wide collar, shallow towards one side and deep towards the other, so that windows may be fully protected without shutting off much light from the remainder of the room. The collars may also be obtained separately for fixing on to shades of the other patterns. All these shades are made in various tints, such as dark green,

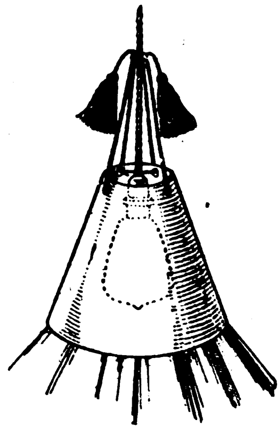


FIG. 1.—SMALL SIZE ANTI-ZEPP SHADE.

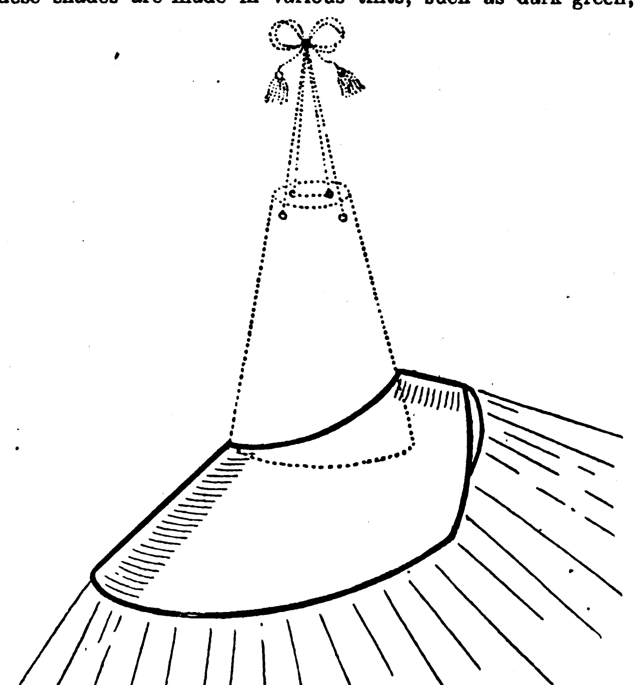


FIG. 2.—ANTI-ZEPP SHADE, SHOWING COLLAR.

pink, brown, etc. As they are sold at a very low price they represent a quick-selling line, which should be very popular at the present time.

Electrolytic Treatment of Zinc Ores.—The *Board of Trade Journal* reports an announcement in the local Press to the effect that works are to be erected at Bowen, Queensland, for the electrolytic treatment of zinc ores. It is understood that the company concerned has for some time past been considering the advisability of putting up such works at either Townsville or Bowen, the main question to be decided being whether it would be better to ship coal to Townsville from the Bowen coalfield, where areas reserved for a State coal mine are to be developed, or to erect the works at Bowen, nearer to the coalfield, and convey the coal to that port. Evidently the decision has turned in favour of Bowen, and an application has been made to the Lands Department for the lease of an area of land at that place suitable for the proposed works. Last session the Queensland Parliament approved the construction of a railway, some 44 miles in length, to connect Bowen with the coalfields on the Bowen River.

ELECTRIC VEHICLE SUCCESS AT MANCHESTER

Additions at Glasgow

FROM the very commencement of the work of the Electric Vehicle Committee it has been recognised that one of the preliminaries to the successful introduction of electric vehicles into any district must be the employment of them by the electric supply authority itself. Municipalities in particular have approached the problem from this point of view, and much of the success which has been attained in the use of the electric vehicle can be traced to the economies which have been shown by the employment of electric vehicles for municipal service generally. One of the most important reports from the standpoint of the propaganda work which will be necessary for some time to come in order to install thoroughly this type of vehicle in public favour has just been issued by Mr. S. L. Pearce, Chief Electrical Engineer to the Manchester Corporation. In this he details a very careful experiment to ascertain whether electrically-driven vehicles could replace the horse cartage carried on by the various departments of the Corporation, and the fact that his results are overwhelmingly in favour of the electric vehicle should do much to encourage the use of these vehicles not only in Manchester but all over the country.

Far from Mr. Pearce endeavouring to build up a case for the electric vehicle, it is admitted that hitherto he has been somewhat sceptical as to the capability of an electric lorry to supplant the horse-cartage system in use by the Manchester Corporation Departments. The past policy has been for the several departments to hire light lorries from contractors, who charge for them at rates varying from 1s. 3d. to 1s. 6d. per hour. The experiment with an electric lorry—which, by the way, was a standard one-ton vehicle, the chassis being by the General Vehicle Co., whose Manchester agents are Messrs. Drake & Gorham, equipped with a 3-h.p. motor and a Standard Edison battery—was arranged so that the carting of several departments was undertaken, thus giving as nearly as possible continuous employment for the vehicle. Owing to the simplicity of the control the employment of a special driver was considered unnecessary and two competent fitter's labourers were trained for the work. An important advantage of this arrangement was that when loading or unloading at the motor shop the driver became a fitter's labourer and booked his time accordingly with a corresponding reduction in the standing charges.

The test was carried out under Mr. H. A. Radcliffe, of the Testing Department of the Electricity Undertaking, and as a result Mr. Pearce feels justified in putting forward figures of the working costs as follows:—Standing charges, 1s. per hour; running costs, 2d. per mile; driver, 7d. per hour. This latter, however, is only charged during the time the driver is actually employed with the lorry as mentioned above.

These standing charges have been calculated on a basis of 2,500 working hours per annum—*i.e.*, fifty hours per week for fifty weeks in a year. The life of the chassis and body has been taken at ten years and written down at 8¾ per cent. per annum, the life of the battery at five years, this being written down at 18¾ per cent. per annum. This latter figure is arrived at by Mr. Pearce himself, as although the makers state that the battery will last for at least ten years, or alternatively for 100,000 miles, their guarantee is only for four years. The possible scrap value of the battery after five years' life has been ignored. The interest on the full capital outlay has been allowed at 4½ per cent. On this basis the actual capital or standing charges work out to 11·95d. per hour, say 1s., but if the interest rate be taken at 5 per cent. this figure would be increased to 12·27d.

With regard to running costs, as the load is an "off peak" one and does not cost the department more than one-third of a penny per unit, the cost of current has been taken at ½d. per unit in order to cover small incidental expenses occasioned by overtime and other charges. The vehicle normally requires about 6·5 ampere-hours per mile or about 0·7 k.w.-hours per mile, but as the efficiency of the motor generator used for charging the vehicle is only about 70 per cent., the actual consumption per mile is approximately 1 k.w.-hour. The cost of tyres has been based on a life of 12,000 miles, whilst repairs and upkeep of the vehicle and battery have been taken at 1d. per mile, which is well in excess of the maker's allowance of 0·6d. per mile. The detailed figures of the running costs, therefore, are current, 0·5d.; tyres, 0·5d.; repairs and upkeep, 1d., making the total of 2d. already mentioned.

The report contains a detailed comparison between the work done by one electric vehicle and one horse lorry. It is pointed out that the cost of a horse lorry per hour is naturally independent of the mileage and that the corresponding cost of the electric vehicle is only 3d. more than for the horse lorry, whilst it is actually 4d. less if the driver is not in attendance. As, however, under any running condition the cost per hour of the electric vehicle is greater than that of the horse vehicle, comparable results can only be obtained by getting more work out of the former in the same time. In other words, the average miles per hour must be higher. Whilst two miles per hour is an average figure for an ordinary horse lorry, experience at Manchester showed that the electric vehicle which was being experimented with was able to undertake the carting of 1·6 departments as carried out by the horses, and that by the organising of the carting rendered possible by the use of a mechanical vehicle the work of 2½-horse lorries was actually done. On this basis it was calculated beforehand that the amount saved per week in the total cartage bill of the Corporation should be £2 6s. 8d., or in a year of fifty working weeks £116 13s. 4d., nearly sufficient to cover the capital charges on the electric lorry. Actual experience over the first five months of this year shows that this result was as nearly as could be achieved. The amount saved by the electric lorry per month was £15 5s. 10d., and taking the weekly cost of a horse lorry as 75s.—*i.e.*, fifty hours at the present rate of 1s. 6d. per hour, or say, £16 6s. per month—and the electric vehicle as the equivalent of 2½-horse lorries, then the reduction on the carting account should be £40 15s. for the five months, and this estimated figure agrees very closely with the actual reduction obtained in the trial.

Mr. Pearce concludes his report with a note of regret at the unduly inflated prices of electric vehicles, and more particularly those fitted with Edison batteries, and then discusses the question of speed. He agrees that the electric vehicle, whilst probably holding its own with a steam vehicle, would not equal a petrol vehicle, at any rate on hills; but the apparently low speed did not prevent an average of 30 miles per day and a maximum on one occasion of 50 miles in the day. As a result of the trial the Electricity Committee is recommended to retain the electric vehicle in question.

The Glasgow Corporation has for some years had a service of electrically driven delivery vans, and their fleet of four vehicles has now been increased by a five-ton automatic tip wagon for the conveyance of ashes from the generating station. Another vehicle to be used for similar purposes is on order, whilst the Cleansing Department has also decided to adopt a five-ton van.

A NEW LAMP CATALOGUE

ONE of the most handsomely produced catalogues of lamps that we have seen lately is the new season's list of "Z" drawn wire lamps that has just been issued by the "Z" Electric Lamp Manufacturing Co., Ltd. (Southfields, London, S.W.), who are anxious to receive the names of anyone in the trade desirous of a copy and not already on their mailing list. The list is complete as well as artistic, and covers practically every type of metal filament lamp from a flashlight bulb to a 1,500-watt half-watt lamp. As is well known, these lamps are the product of British material and labour, and owing to the large stocks which have been accumulated, including "half-watt" lamps, early delivery can be given of practically every size and voltage. In addition to the usual range of standard one-watt lamps, there are many special lamps, such as plain and twisted candle lamps, the firm's own patent "Zedlite" candle, traction and train lighting lamps. The half-watt lamps range from the comparatively new small sizes right down to 15 watts 25 volts, include the useful 100-watt size for all voltage from 25 to 255, and run right up to the 1,500-watt size giving about 3,000 c.p. Motor-car lamps are also dealt with in the list, and other special lamps include low-voltage series lamps for signs and illuminations fitted with Downes series device and automatic cut-out in the base of the lamp.

Manchester Municipal School of Technology.—Vol. viii. of the *Journal* of the Manchester Municipal School of Technology contains a record of investigations by some members of the school during the year 1914. It consists of 264 pages, and among the subjects dealt with are the dilution limits of inflammability of gaseous mixtures; the commutation of C.C. generators and rotary converters; a null method of testing vibration galvanometers; and the ignition of gaseous mixtures by the electric discharge.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published October 19th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad

13,801/15. **Series Regulation.** R. THURY. A method of regulating constant current series machines, in which an exciter is provided, the field, of which is differentially excited by the line current and a current derived from a constant voltage source, and further by a compounding coil, the effect of which depends on the voltage across the terminals of the machine. The stability and sensitiveness of the regulation can be improved by the provision of a transformer, the primary of which carries a current proportional to the line current, while the secondary voltage impulses arising from variations in the line current, are arranged to operate in series with that of the exciter.

16,694/15. **Searchlights.** A. H. RAILING and A. E. ANGOLD. In arc lamps for searchlights, &c., using horizontal flame carbons of small diameter, and with an arc sufficiently long to be influenced by the updraught, placing the point of the negative carbon lightly above the axis of the positive carbon, with a magnetic control for the arc of such a strength and direction as to cause the arc to strike the positive carbon true on the axis, and the incandescent gas to envelope its end.

8,754/16 (*101,523*) **Motor Control.** IGRANIC ELECTRIC Co. (*Cutler Hammer Mnf. Co.*).—A controlling system in which the series-wound accelerating contactors controlled by it will provide step by step regulation both during acceleration and deceleration without the motor-circuit being interrupted. Two or more series of electro-responsive accelerating switches are provided, each fitted with series actuating and lock-out windings and a shunt lock-out winding connected to act cumulatively with the series lock-out winding to govern the closure of the switch electromagnetically. One switch of each series is provided with a further shunt coil adapted to control the motor during deceleration.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: G. RUSHTON and L. R. LACY [Earthing conduits] 7,347/16 (*101,604*); C. VERNIER [Cable joint boxes] 10,554/16 (*101,343*).

Dynamos, Motors, and Transformers: BRITISH THOMSON-HOUSTON Co. (*G.E. Co., U.S.A.*) [High-frequency machines] 13,904/15; NEULAND [Power-transmission apparatus] 13,912/15, & [Dynamos] 14,160/15; WALKER [Commutator machines] 14,216/15; SHAW, SHAW, and SHARP [A.C. Motors] 14,650/15.

Electrometallurgy and Electrochemistry: C. CHURCHILL & Co. and E. GEERAERD [Electrolytic cells] 6,735/16 (*101,598*).

Ignition: A. E. LAMKIN [Sparking plugs] 5,240/16 (*101,592*).

Instruments and Meters: MEANS [Synchroscopes] 14,047/15.

Switchgear, Fuses, and Fittings: K. PETERSEN [Current limiters] 894/16 (*100,048*); J. HARRINGTON [Lamp-locking fittings] 8,521/16 (*101,607*); A. G. BROWN, BOVERI & CIE [Carbon pressure regulators] 8,698/16 (*100,788*).

Telephony and Telegraphy: INTERNATIONAL ELECTRIC Co. and LE NOIR [Portable telephone and telegraph instruments] 14,232/15 & [Telephones] 14,233/15; V. G. WERNER and K. H. WARFVINGE [Telephony with moving trains] 11,658/15 (*101,343*).

Miscellaneous: WALL [Minimising sparking at break of a circuit containing inductance and capacity] 13,568/15; LOVELACE, FORD, and EDISON & SWAN UNITED ELECTRIC LIGHT Co. [Bells] 13,806/15; RICHARDSON and GILL [Electrical indicating devices for taxi-cabs] 17,533/15 WILSON, ANDERSEN and CURTIS [Electric welding] 17,917/15; T. Y. UNWIN and BRITISH EVER READY Co. [Flash-lamp attachments] 4,413/16 (*101,585*); ALLMANNA SVENSKA ELEKTRISKA AKTIEBOLAGET [Couplings] 9,745/16 (*100,948*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Heating and Cooking: H. A. RICE [Stoves and toasters] 13,664/16 (*101,634*).

Incandescent Lamps: DEUTSCHE GASGLUHLICHT A.G. [Exhausting bulbs] 9,608/16 (*101,621*) and [Incandescent lamps] 9,609/16 (*101,622*).

Amendment allowed

399/14. **Telegraphy:** J. S. WITHERS (*K. C. Cox*). This specification which describes a selenium cell relay for cable telegraphy has been amended by way of disclaimer.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Incandescent Lamps: C. C. REGNART [Candle lamps] 14,754/03.

Telegraphy and Telephony: F. RITCHIE [Combined telephone and telautograph exchange] 14,401/08.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN .

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

QUESTION No. 1,514.

It is proposed to instal a 1,500-ampere hour battery of 122 cells to take the night load of a station, the total generating capacity of the oil sets being 400 kw. and voltage 220. It is possible that the battery would be subjected to a load of 500 for half an hour during the night, the load for the remaining period being much less. Fourteen of the cells will be fitted as "End Regulating," and a booster will be installed for "day charging" the battery. For this purpose it is proposed to use an existing booster set consisting of a shunt motor driving two series boosters each 30 volts at 600 amps., and to rewind these boosters to give 90 volts when in series. Is it considered practicable to increase the speed of the set to obtain the required 50 per cent. increased volts and thereby avoid rewinding the armatures? Is it essential to rewind the series booster fields to be of the shunt type, and should the boosted volts be regulated by means of the motor or the generators? If the set was arranged to be reversible in lieu of having "end regulating" cells, state what precautions must be taken in designing the switchgear, having in mind particularly the satisfactory operation of switching the boosters in and out of circuit whilst a current is flowing through the apparatus. "BOOSTER."

(Replies must be received not later than Monday, Nov. 6th.)

ENGINEERING AND SCIENTIFIC SOCIETIES: 1916-17 SESSION

THERE is every indication that the various engineering and scientific societies throughout the country are making an effort to carry out during 1916-17 more or less their usual programmes, notwithstanding the difficulties which at present are encountered in securing a supply of papers. As we announced last week, the opening meeting of the session of the Institution of Electrical Engineers takes place on Thursday, November 9th, at 8 p.m., when the premiums awarded for papers read or published during the past session will be presented and the eighth Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," will be delivered by Dr. Alexander Russell, Vice-President.

Activity is also being shown in the preparation of the Local Section programmes, but at the time of going to press only one has come to hand, namely, the Western Local Section. The opening meeting took place at Bristol on Monday, when Professor David Robertson delivered his chairman's address. Future meetings of this section will be held on December 11th, February 5th, and April 2nd. The Newcastle Section, however, holds its first meeting on November 13th, when the chairman, Mr. H. W. Clothier, will give his address.

The Institution of Civil Engineers opened its session on Tuesday, when the James Forrest Lecture on "The Development of Appliances for Handling Raw Materials and Merchandise at Ports and other large Centres of Traffic" was delivered by Sir John P. Griffith.

No alteration also as to the number of meetings during the session has been made by the Institution of Mechanical Engineers, which commenced on Friday last with a paper on "Trials on a Diesel Engine and Application of Energy Diagram to Obtain Heat Balance," by the late Lieut. Trevor Wilkins. This paper was presented by Professor Burstall, of Birmingham. The Thomas Hawksley Lecture is to be delivered on November 3rd.

One of the youngest institutions—namely, the Greenock Electrical Society—has again prepared an attractive programme for the session. On the 19th inst. a paper on "Steam Turbines" was delivered by Mr. A. Norwell, and the following is the programme for the remainder of the session:—November 2nd.—Open night for discussion. November 4th.—Visit to Glasgow Corporation Dalmarnock Electricity Station. November 16th.—"A Criticism of the I.E.E. Rules," by H. Piggott. November 23rd.—Visit to Overton Paper Mills. (Members to meet at 7.30 p.m.) November 30th.—"What is Electricity?" by J. L. Hoog. December 5th.—Visit to John Drummond and Sons, Rue-End Street. (Members to meet at 7 p.m.) December 14th.—"The Art of Wiring," by J. Nichol. December 21st.—Open night to be devoted to the reading of papers submitted by junior members. January 11th.—"Factory Installations," by R. T. Patterson. January 18th.—Visit to the Brewers Sugar Co., Ltd., Cereals Works, Westburn Square. (Members to meet at 7.30 p.m.). January 25th.—Open night for discussion. February 8th.—"H.T. Conduit Systems," by H. J. Roberts. February 17th.—Visit to Dellingburn Power Station. (Members to meet at 2.30 p.m.) February 22nd.—"Electricity Supply Costs," by F. H. Whysall. March 8th.—"Notes on the High Speed Engine," by S. V. Thorp. March 22nd.—"Electric Welding," by D. Angus. March 24th.—Visit to Gateside Colliery, Cambuslang. March 29th.—General Meeting.

Considerable activity is being shown by the North-East Coast Institution of Engineers and Shipbuilders, particularly in giving assistance to manufacturers in the matter of research, and the annual general meeting is to be held to-day (Thursday) and to-morrow (Friday). A paper on "Works Organisation" is to be read, the three sections of which, "Manufacturing Organisation," "Financial Organisation," and "Selling Organisation" have been prepared by Messrs. A. D. C. Parsons, E. L. Orde, and G. H. Tweddell respectively.

The Association of Supervising Electricians also has been successful in securing papers for the whole session Mr. A. P. Trotter's Presidential Address, which was delivered on September 26th, was referred to in our last issue. The remainder of the programme is as follows:—October 31st, "Electric Heating and Cooking," by A. F. Berry; December 12th, "Electric Meters," by J. Rennie; January 16th, half-yearly meeting and informal discussions; February 27th, "Modern Power Cables," by H. Savage; April 23rd, "Wiring Rules of the Institution of Electrical Engineers," by W. R. Rawlings; May 8th, "Motor-control Gear," by J. T. Mould; June 26th, annual general meeting. The meetings, which are held at St. Bride Institute, Ludgate Circus, E.C., begin at 7.15 p.m.

Mr. Frank Bailey opened the season's work of the Association of Engineers-in-Charge with his Presidential Address on October 11th, referred to on another page of this issue, and a number of interesting papers have been secured, including one on "Solid Fuels," by Mr. G. G. Martlew, on December 13th.

The Junior Institution of Engineers again intends to carry on its usual interesting Friday evening lecturettes, and the first ordinary monthly meeting of the session was held on October 18th, when Mr. F. H. Taylor read a paper on "Industrial Lighting by Electricity," referred to elsewhere in this issue.

The Physical Society holds its first meeting of the session to-morrow, Friday, at the Imperial College of Science, South Kensington, S.W.

Mr. T. M. Newell will deliver his Chairman's Address to the Liverpool Engineering Society on Wednesday, November 1st, and among the papers which have been arranged for during the session are: January 24th, "The Education of Apprentices to Engineering and Allied Trades," by Tom R. Thomas; February 7th, "The Gladstone Dock," by W. A. Oglethorpe; March 21st, "Equipment of King George Dock, Hull," by J. Leighton.

THE ENGINEERING INDUSTRY AND THE WAR

IN his Presidential address to the Association of Engineers-in-Charge on October 11th, Mr. Frank Bailey (Chief Engineer, City of London Electric Lighting Co.), discussed in a general way the position of the British engineering industries and the means that should be taken to enable this country to maintain and improve its position. The progress which the Germans had made during the last 40 years had been obtained, he said, by methods dishonourable in war and unfair in peace. Our energies must be concentrated on meeting the menace of German intrigue and trade competition when they have recovered from the knock-out blow to their military prestige. The engineering facilities of this country were already being organised, and the ultimate goal of a combined federation appeared to be nearly accomplished. The call for munitions of war, he said, received a response which shows the value of co-operation and the ability of the nation to adapt itself to requirements, and an output has been obtained which proves the vitality and the powers of resource still left in the country. The rapid adaptation of tools and appliances and the production of vast equipment of automatic and other machinery may have beneficial influence on our future progress. This increase of automatic machinery, etc., had caused a redistribution of skilled labour, which was more concentrated in the erecting-shop and the tool-room than formerly. Other factors, he continued, had affected the responsibilities of the engineer-in-charge, for few works can now afford to generate their own power, and the relief from the annoyances of a steam or gas plant must be very acceptable to the engineer-in-charge, unless this relief leaves him with nothing else to do. Such a total relief would imply that the driven machines or plant required no supervision or attention, and that everything was so perfect as to avoid the possibilities of wear and tear or antiquation, and that the men employed required no supervision. This implication is obviously erroneous, and the wise employer would rejoice that the elimination of one source of expense and annoyance enabled concentration of skilled effort to be devoted to the increase of economical production.

Mr. Bailey then discussed the general position of imports and exports of this and other countries, emphasising the necessity for corn, etc., being obtained as far as possible within the empire, and increasing the export of manufactured articles. In investigating the trade prospects of Germany before the war, he contrasted German and British banking systems, and urged the foundation of British industrial banks. With regard to the much discussed question of research facilities, he said that we could admire, even if we envied, the opportunities created by German prodigal outlay for the assistance of their manufacturers, but we need not forget that a large proportion of discoveries leading to useful inventions or to improved processes had been due to the work of British men of science. Speaking of the labour position after the war he said: "The first duty of employers is to reinstate those workers who have become soldiers and are to-day risking their lives to help their country and to keep the British flag well in the front. The best workers have made the best soldiers; they have seen how united effort produces the best results, and that discipline and loyalty are

necessary to prevent confusion, and to enable the trained expert to lead them to victory. Thousands of workers will bring this message back with them when they return to take up their ordinary occupations, and, whether sound or maimed, they will bring with them renewed confidence in their vitality and in their power to overcome difficulties. On the other hand, it may be feared that many of those who have stayed at home, and are earning high wages, will develop an opinion of their skill and abilities which, unchecked by the salutary influence of discipline, may lead to some deplorable conflict of interests. The martial severity of war-time legislation has checked unreasonable demands and the turbulent elements sometimes found in the organisations representing labour, but there are even now signs that the eloquence of the agitator may be used to test the loyalty of the returning soldier worker."

TELEPHONY AND TELEGRAPHY (INCLUDING WIRELESS)

The contemplated semi-automatic telephone system in Liverpool has been put aside for the moment, mainly on the question of cost. The Central Exchange is at present congested, and some of the lines have been transferred to the Bank Exchange, but the idea is ultimately to amalgamate the two exchanges.

A full automatic exchange on the Automatic Telephone Manufacturing Co.'s system has been erected at Blackburn and will shortly be put into operation. A similar exchange is already working at Accrington and, of course, at other towns in the country, but the Blackburn exchange has been erected in order to establish direct automatic working with Accrington. The exchange provides for 2,400 subscribers, but the ultimate capacity is to be 4,400.

LOCAL NOTES

Birmingham: *Supply Interruptions.*—An explanation was given at the last meeting of the City Council with regard to the rather frequent stoppages of the tramways due to the failure of the electricity supply. The short fact is that the whole of the plant of the Birmingham Electricity Department is now working at abnormal pressure and proper maintenance is being seriously interfered with. Additional plant is being installed and it is hoped that further mishaps of the kind will be avoided, if only that the larger margin of plant will enable the machinery to be kept in proper condition. These happenings at Birmingham should be a warning to those Councils in other towns who are rather prone to advocate the policy of economy in capital expenditure at present. This form of "economy" is likely to prove far from economical in the long run.

Carmarthen: *The Street Lighting Contract.*—The Council has a contract with the Carmarthen Electric Supply Co. for the maintenance of 282 street lamps, but, owing to the lighting restrictions, only 32 are now allowed to be kept lighted. In the circumstances the Council applied to the company for a rebate, but the latter refused to accede to this request. The facts have been placed before Mr. Walter Long, President of the Local Government Board, who in replying that he is making enquiries expresses the view that cases of this kind should be settled amicably between the parties. According to a decision in an action between a small gas company and a local authority in similar circumstances a short time ago, the local authority is bound to pay the full price of the contract, notwithstanding the lighting contractor is unable to carry out his part of the contract through the action of the authorities. There have, of course, been innumerable cases of this kind, but as only one has been the cause of a legal action it is evident that mutual arrangements are being made.

London.—*Islington: Electrical Employees' Wages.*—The Electricity Committee, having refused an application for an increase of 2d. per hour for all men employed at the electricity works receiving 7d. per hour, the men applied to the Munitions Tribunal for certificates to enable them to leave the Council's employ. Such certificates are, of course, necessary, as the electricity works is now a controlled establishment. When the case was heard it was contended on behalf of the Council that it is not bound by union rates of wages, and, moreover, that the conditions of employment were more favourable to the men than those of private employers. The Tribunal, however, did not accept this view, and the further consideration of the point was adjourned for two weeks to give the parties an opportunity of endeavouring to come to an arrangement. The Emergency Committee subsequently inquired into the rates of wages paid by other municipal electricity undertakings in London, and informed the men of its willingness to recommend the Council to pay a similar rate. At the last meeting of the Council it was reported that the men had rejected these proposals, and that another application had been made by them to the Tribunal for leaving certificates.

St. Annes-on-the-Sea: *Electricity Accounts.*—The accounts of the electricity undertaking for the year to March 31st, 1916, show a net profit of £259. During the year the reserve fund of £5,491 has been reduced to £4,084 by expenditure upon the purchase of a new boiler and condenser and upon new meters. The average cost of coal was 18s. 7d. per ton, compared with 14s. 2d. in 1914-15, and the expenditure involved on this account was £1,346 in excess of that of the previous year. The number of consumers was increased by 103 during the year and the number of units sold by 112,597.

Winchester: *Electricity Charges.*—Those electricity users whose consumption is very small have been circularised inviting them to increase it to the value of £2 6s. 8d. per annum in order to avoid the necessity of making the minimum charge which the committee is entitled to do by its Act of Parliament. The bills of a number of consumers at present do not exceed 2s. per quarter.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £145 to £146 (last week £142 to £144).

Agencies.—H.M. Consul at Milan has received enquiries from a firm desirous of obtaining agencies for United Kingdom manufacturers of electrical fittings.

A Sydney agent desires to represent United Kingdom manufacturers of electric lamps.

Another Sydney agent desires to represent British manufacturers' electric conduit. Further particulars at 73, Basinghall Street, E.C.

Change of Address.—In order to accommodate a Government Department, the Swedish General Electric, Ltd., are temporarily vacating their offices at Canada House, Kingsway, London, for the period of the war. On and after November 10 communications should be addressed to the firm at 5 Chancery Lane, London, E.C. Telephone: Holborn 1703. Telegrams: Autosyncro, Fleet, London.

Switching Examination.—Messrs. A. P. Lundberg and Sons have just got out a new edition of their 6 pp. Exam. Folder, giving particulars of their Free Examinations in Electric-Light Switching. The fresh selection of unsolicited expressions of opinion from examinees given therein make interesting reading, and a reference is made to the good opinions of central station chief engineers, professors, and teachers, which appear in other of the firm's publications. All these, together with the opinions of the electrical Press, go to show that the subject of electric-light switching has fully justified its claim to be an important branch of electrical installation work.

Benjamin Electric, Ltd.—Arrangements have been made by Messrs. Benjamin Electric, Ltd. (1a, Rosebery Avenue, London, E.C.), to represent in England, Ireland, Scotland, and Wales, Messrs. Pass and Seymour, of Syracuse, N.Y., U.S.A., for the sale of P. & S. Handy Electrical Wiring Devices.

Dissolution of Partnership.—Stephen Richards and J. S. Rhodes, trading as Richards and Rhodes, electrical engineers, at Station Buildings, Keighley, have dissolved partnership. Debts by Stephen Richards, who continues the business.

Liquidations.—The Resisto-Electrical Manufacturing Co., Ltd., is to be wound-up voluntarily. Mr. De Westley Layton, 167, Fenchurch Street, E.C., is liquidator. A meeting of creditors was held at the offices of Messrs. Lowe, Bingham and Matthews, Thorner's Chambers, Ingram Court, 167, Fenchurch Street, E.C., on Friday last.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Manchester.—The Electricity Committee require for the Bloom Street Generating Station low-pressure water and exhaust steam pipes and supports. Further particulars from the Chief Electrical Engineer, Dickinson Street, and tenders to the Chairman, Electricity Committee, October 30th.

New Zealand.—A copy of the specification and tender form for a motor generator with accessories and squares required by the Dunedin Council may be seen at 73 Basinghall Street, E.C. Tenders to the City Electrical Engineer, Market Street, by January 24th.

Miscellaneous

Bradford.—The Tramways Department requires twelve months' supply of various stores. Town Clerk, Nov. 11th. (See an advertisement on another page).

Glasgow.—The Corporation Cleansing Department requires a six months' supply of electrical materials. Superintendent, 20 Trongate, Glasgow, October 28th.

South Africa.—The Johannesburg Council requires a supply of 500 or 1,000 tramcar trolley wheels. November 20th.

The Council also requires 1,000 sets of single-pole iron-clad house service cut-outs. Tenders by November 27th.

Specifications may be consulted by British manufacturers at 73 Basinghall Street, E.C.

Wolverhampton.—Wiring (400 points) for the New Bushbury Works of Messrs. MacFarlane and Robinson. October 30th.

APPOINTMENTS AND PERSONAL NOTES

Mr. C. W. Saddington has been appointed Borough Electrical Engineer at Oban in succession to Mr. D. M'Lennan who, as we announced last week, has resigned.

Mr. S. Williams, Borough Electrical Engineer at Wishaw, who has resigned to take over a position in the Navy, is to be succeeded by Mr. C. T. Astburg, Electrical Engineer to the Atherton (Lancs.) Urban District Council.

A lecturer in engineering (preferably electrical) is required for the Loughborough Technical Institute. The salary is from £150 to £175 per annum, according to qualifications. Applications to the Principal, by November 1st.

Lieut. W. H. Kember, South Lancashire Regiment, of Bolton, who is reported wounded and in hospital, was, prior to taking up military duties, engaged at the British Westinghouse Works, Manchester.

Mr. Sherard Cowper-Coles has entirely severed his connection with the Homogenous Lead Coating Co., and is carrying on his business at 1 French Street, Sunbury-on-Thames.

Restriction of Imports of Insulating Materials.—The B.E.A.M.A. announces that the Department of Import Restrictions (Board of Trade) has granted to the Association a special licence to import insulating materials in certain classes which are included in the list of prohibited imports. Electrical manufacturers, whether members of the Association or not, can avail themselves of this licence by making application to the Secretary of the Association. The Department of Import Restrictions desires it to be known that the granting of this licence is a temporary measure to meet present urgent needs. The licence extends to January 16th, 1917, at which time the necessities of the situation will be again reviewed. It is expected that firms in the meantime will make every effort to obtain in this country the supplies of insulating material which they require.

The Sperry Searchlight.—In connection with the article in last week's Electrical Engineering, giving some particulars of the Sperry searchlight, the Sperry Gyroscope Co., Ltd. (15 Victoria Street, S.W.), write us stating that a searchlight with this lamp gives a target illumination of more than eleven times that of an ordinary carbon arc searchlight of equivalent size. They also claim exceptional steadiness and uniformity for the beam, and point out that it is the only high intensity searchlight with which it is possible to ventilate the barrel thoroughly to prevent the clouding of the glasses by the products of combustion, which has given trouble in other forms of lamp. The carbons used have also a considerable advantage over the German type of flame carbon in that they do not emit fluorides which corrode the front glass and mirror.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Dick Kerr and Co.—The report and accounts for the year to June 30 show a net profit after meeting debenture charges of £60,900, compared with £36,300 in the previous twelve months. After transferring £25,000 to contingencies account, the ordinary shares are to have a dividend of 6 per cent. This is the first distribution of the kind since 1910-11, when 5 per cent. was paid. The balance of £20,400 is carried forward. The report makes note of the interesting fact that during the year the Company acquired control of Messrs. Willans and Robinson and the directors anticipate that this acquisition will be of considerable value in the future expansion of business. An amount has been set aside for special taxation, but the actual figure is not given in the report and accounts.

CATALOGUES, PAMPHLETS, &c., RECEIVED

"Z" BLOTTERS.—The "Z" Electric Lamp Manufacturing Co., Ltd. (Southfields, London, S.W.), has kindly sent us some of the advertisement blotters which are being distributed free of cost to the trade.

DIRECT CURRENT MOTORS.—The Swedish General Electric, Ltd., Canada House, Kingsway, London, W.C., have issued an October list containing a general description of their "Century" single phase motors.

NEW COMPANIES

NEW UNION ELECTRIC CO., 53/57 Park Street, Southwark, S.E. Capital £2,950 (1,667 founders' and 1,283 ordinary). To take over the business hitherto carried on as the Union Electric Co., Ltd.

The Lake Coleridge (N.Z.) Power Scheme.—The results obtained by the Government scheme for the development of hydro-electric power from Lake Coleridge, which has been in continuous operation for a complete year, have justified the most sanguine anticipations. Three units of generating machinery were originally installed, capable of an output of 6,000 h.p. Twelve months ago the demand for current warranted the installation of a fourth unit of 2,000 h.p., and the expanding business now necessitates the addition of a fifth unit, comprising pipe-line, turbine and generator of 4,000 h.p. During the year the maximum load on the plant reached 1,770 h.p., which is less than the capacity of any one of the units installed. In these circumstances, it is pointed out in the Public Works statement for 1916, the business could not be expected to show a profit, but, on the other hand, at the end of 1915 the plant was earning sufficient to cover working expenses. Contracts to the extent of 8,000 h.p. have already been entered into, and when the power under these contracts is being supplied it is confidently anticipated that the plant will be earning sufficient to pay interest in full as well as working expenses.

The War and the Electrical Trade.—In his presidential address to the Birmingham and District Electric Club last week, Mr. G. O. Donovan dealt with the effects of the war on the electrical trade. He pointed out that, our electrical export trade being small compared with the home market, the important question was whether, after the war, the home market was to be maintained, or whether it was to fall off. He was inclined to think it would fall off, and for this reason efforts must be made to improve the export trade. Foreigners, at any rate, would buy in the cheapest market, and if British manufacturers were not prepared to come down to the prices of their competitors and supply exactly what was required, the trade would go to other nations. In this connection, however, the Government must ensure manufacturers a plentiful supply of cheap material, and labour must be moderate in its demands, otherwise manufacturers could not be expected to spend money in opening up new fields, and, obviously, if this position were brought about, employment would suffer.

Royal Engineers: Wireless Section.—The Wireless Section, R.E., has vacancies for a number of electricians and instrument repairers with good practical knowledge. Engagement for the period of the war only. Applications for enlistment, stating qualifications, should be sent to the O.C., Wireless Training Centre, Worcester, from whom information regarding terms of service can be obtained. Men would be required to enlist as sappers in the Wireless Section of the Royal Engineers, but prospects of promotion for satisfactory men are good.

ELECTRICAL ENGINEERING

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SUMMARY

THE report of the Chief Inspector of Mines for 1915 contains references to a few cases of electrical accidents in mines (p. 414).

A FURTHER report by Dr. R. V. Wheeler on electric signalling with bare wires in mines has been issued. It defines the precautions necessary for the bare-wire signalling system to be rendered safe (p. 414).

SOME references to electrical cargo-handling machinery were made by Sir J. P. Griffith in his "James Forrest" lecture at the Institution of Civil Engineers (p. 416).

AMONG the subjects of specifications published at the Patent Office last Thursday were high-frequency alternators, power transmission gear, commutation, and cable joints (p. 418).

THE design of a direct-pull solenoid is discussed in our "Questions and Answers" columns (p. 418).

THE B.E.A.M.A. has been successful in obtaining a concession in the matter of the allowance to be made for the purposes of excess profits assessment (p. 419).

THE Glasgow Corporation has decided to proceed with a portion of the Dalmarnock power station (p. 420).

ROTARY converters and switchgear are required at Newport (Mon.); high-tension switchgear at Sydney, N.S.W.; electric lamps and fans at Alexandria; and a 50-ton electric travelling crane for the N.S.W. railways power house (p. 420).

A DIVIDEND of 4 per cent. is paid on the ordinary shares of Drake & Gorham for last year (p. 420).

NATIONAL ELECTRIC POWER SUPPLY

FOLLOWING on the memorandum issued by the National Electric Power Supply Joint Committee (ELECTRICAL ENGINEERING, October 12, p. 384), a meeting of the Engineers of the electrical undertakings in Yorkshire was held on Wednesday last, October 25, at the Philosophical Hall, Leeds, when about 38 Engineers were present. Mr. T. Roles, City Electrical Engineer, Bradford, presided.

The meeting decided upon the formation of a County Committee to obtain the necessary information upon which they will report to a later meeting. The Committee was appointed as follows, the gentlemen named being Municipal Electrical Engineers unless otherwise stated :—

Mr. E. Cross (Rotherham), Mr. S. E. Fedden (Sheffield), Mr. C. N. Hefford (Leeds), Mr. Jewell (Yorkshire (West Riding) Electric Tramways, Wakefield), Mr. S. D. Jones (Batley), Mr. H. A. Nevill (Wakefield), Mr. E. S. Rayner (Doncaster, representing also Barnsley), Mr. T. Roles (Bradford), Mr. H. Webber (Keighley), Mr. G. Wilkinson (Harrogate), Mr. W. B. Woodhouse (West Yorkshire Electric Power Co.), together with Mr. W. M. Rogerson (Halifax), who was appointed secretary.

DIESEL ENGINE USERS' ASSOCIATION

AT the first meeting of the session of the Diesel Engine Users' Association alterations and additions were made to the rules. From the end of the current year an entrance fee of one guinea is to be charged to all new members. To meet the demand from outside for copies of the reports of proceedings and of the general information and data circulated by the Association, provision has been made for a class of subscribers. These will consist of individuals or firms who are not qualified for full membership, but who will be entitled to receive the particulars circulated on payment of a sum of one guinea per annum. They will not be entitled to attend the meetings of the Association (except by special invitation of the Committee), neither will they have any voice in the control of the Association. Subscribers, however, may send in to the Hon. Secretary points of interest which may be discussed if thought fit at any particular meeting.

Air-Compressor Explosions and Troubles.—A report on Explosions in Air-Compressors and on the various troubles experienced with air-compressors, having special reference to the accident which occurred at the Generating Station of the Smithfield Markets Electric Supply Company, Limited, in February last, was presented and adopted. It will be circulated in due course.

Tar Oils as Fuel for Diesel Engines.—Mr. Napier Prentice gave further information in connection with the application which had been made by the Suffolk Electricity Supply Company, Ltd., for the voidance or suspension for the duration of the war of the Konrad Aust patent for the use of tar oils as fuel in Diesel engines. Since the application had been made, however, his experience in the use of tar oils in Diesel engines without the fitting of any pilot ignition apparatus had been so satisfactory that he did not think it would be advisable that his company should incur any costs in connection with the adoption of the method of working covered by the patent. He was now effecting a saving of about 50 per cent. in fuel costs by the partial use of tar oil.

Mr. Geoffrey Porter (President) gave particulars of a pilot ignition apparatus which had been fitted to a Diesel engine at Worthing. The saving in fuel costs obtained by using tar oil in this manner with about 10 per cent. of crude oil for the ignition charge amounted up to date to about 47 per cent. The only trouble experienced had been in connection with the formation of a deposit which choked the pulverisers. No trouble had been experienced with the exhaust valves or with the needle valves. On another engine a mixture of three parts of tar oil to one of crude oid has been tried. The engine knocked rather heavily, but at three-quarters full load, and with fairly continuous running, no further troubles had been experienced. Mixtures of tar oil and crude oil, however, are not favoured as there is some risk of mis-firing, and a difficulty in securing complete mixture of the two classes of fuel oil.

Further information of the subject of actual experience in the use of tar oils was given by Messrs. W. A. Turnbull, F. W. Strickland, J. Broadhurst and W. Fennell, and Mr. Napier Prentice strongly urged that on national grounds as well as in their own interests Diesel engine users should continue to endeavour to make use of home products of fuel oil to the greatest possible extent in preference to fuel oil imported from abroad.

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE.
ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week: Platoon Commander Hughes Hallett.
Next for Duty: Platoon Commander J. O. Cheadle.

Mon., Nov. 6th: Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits Drill, 6.25 to 8.

Tues, Nov. 7th.—School of Arms, 6 to 7. Lecture, 7.15, by Sergt. J. Roberts, "The Measurements of Angles." Range Practice.

Wed., Nov. 8th: Instructional Class, 6.15. Platoon Drill, Platoon No. 12. Range Practice.

Arrangements for the Week.—To-day (*Thursday*). *Nov. 2nd.*—Greenock Electrical Society, at 22 West Stewart Street. Open night for discussion. 7.45 p.m.

Wednesday, Nov. 8th.—Institution of Automobile Engineers, "Electrical Car Equipment," by A. Ludlow Clayton, at Royal Society of Arts, John Street, Adelphi, W.C., 8 p.m.

Faraday Society at Institution of Electrical Engineers. Discussion on Refractories, 5.30 p.m.

Thursday, Nov. 9th.—Institution of Electrical Engineers, Eighth Kelvin Lecture. "Some Aspects of Lord Kelvin's Life and Work," by Dr. A. Russell, 8 p.m.

ELECTRICAL ENGINEERING IN
THE MINING AND METAL INDUSTRIES
Published on the First Thursday of each month

ELECTRICITY IN MINES IN 1915

THE reports of the Divisional Inspectors of Mines are this year incorporated in Part I. of the Chief Inspector's Report, and, due to the increased attention being paid to economy, are much less voluminous than usual.

The fatal accidents in coal mines during 1915 attributed to electrical causes were four in number, one in the Northern, two in the South Wales and one in the Midland districts on the surface, and eight underground, of which three were in Scotland, two in the Northern, two in the South Wales, and one in the Midland districts. No electrical fatalities are reported in the metalliferous mines, although one is recorded in connection with a quarry.

With regard to the fatalities in Scotland, Mr. H. Walker, the inspector for that division, writes:—The three deaths due to electricity should not have occurred. In one case an apprentice, aged 15, probably from curiosity, opened the door of a switch panel, where the pressure of the current was 2,750 volts, and touching live metal was electrocuted. In the second case where a fall from the roof had occurred and covered a cable carrying current to a coal cutter, two men were set to work to clear the debris although the current was not cut off. Such an ordinary precaution does not appear to have been thought necessary by the officials, if they thought about it at all, who set the men to work. One of the men received a shock by way of his shovel which either penetrated the cable or touched the conductor owing to the outer covering having been injured by the fall. The third case was due to the absence of a locking pin to cause efficient contact between the frame of a coal-cutting machine and the earth conductor in the trailing cable. As remarked, it will be seen that each of these accidents could easily have been prevented.

It is also interesting to note the following reference to an accident in a metalliferous mine in his report:—

"There was one fatal accident during the year, compared with two in 1914. It was due to a miner mistaking the explosion of another shot for that of one he had just lighted. He returned to his working place and was killed by the explosion of his own shot. *Electric firing would have prevented this accident.*"

Mr. J. R. R. Wilson's report for the Northern Division mentions an unusual accident, fortunately not a serious one, although it involved the loss of considerable property, which happened to a man in charge of the safety lamps at the Easington Colliery, Durham. This man was burnt about the arms while attempting to extinguish the flames from the burning celluloid cases of electric safety lamp accumulators. The origin of the fire is not definitely known, but it is suggested that in the process of charging, liquid may boil out of one cell and creep down the sides and across to the outside of an adjacent cell, thereby causing a short circuit and an arc. As may be imagined, with such a material as celluloid, unless immediate attention is at hand, a conflagration of considearable dimensions is soon inevitable. In this case the batteries of some 1,200 lamps were rapidly involved; in fact, the celluloid was consumed in about 10 minutes or less. The fittings in the lamp room were chiefly of wood; the roof also was partly of wood, so that the whole interior, including the roof, was rapidly gutted. Work was resumed at the mine after a stoppage of one day only, as, owing to so many men having left the neighbouring collieries, a sufficient number of oil safety lamps were available.

Mr. T. H. Mottram's report for the York and North-Midland Division, mentions an underground fire at Fryston in a main haulage road, which caused the death of a deputy and a pony driver. The fire occurred in the main intake about 1,000 yards from the pit bottom. The roadway dipped inbye from 1 in 8 to 1 in 10 and was about 12 feet wide and 7 feet high, an electric cable for supply current to seven motors of a total of 130 h.-p. being suspended to the roof supports, which, for the most part, consisted of girders and covering wood supported by props. The covering wood took fire and it was some hours before the fire could be subdued, notwithstanding that the supply of water was plentiful. Investigation showed that a set of 20 full tubs ran away through a stop catch being either put temporarily out of action by being spragged to allow empties to pass, or by dirt accumulating in the catch box, and by damaging the electric cable referred to, caused the fire through arcing. The cable was a twin core dielite insulated armoured with single wire. The view of Mr. Charlton, H.M. Electrical (temporary) Inspector of Mines, was that by the accident the cable was torn rather than cut in two; that at first there was not a dead short; that the two conductors were not fused and an arc was probably established and maintained, taking a gradually increasing current after the metallic covering had been removed. He was also of opinion that had the protective device been actuated by leaking current instead of the main feeding current the fire would not have occurred. The cause of the fire could not, however, be laid to contraventions of the Electricity Regulations, and the owners, on being asked to instal a leakage current protection device, agreed to do so.

ELECTRIC SIGNALLING WITH BARE WIRES IN MINES

A FURTHER report by Dr. R. V. Wheeler and Prof. W. M. Thornton on electric signalling with bare wires so far as regards the danger of ignition of inflammable gaseous mixtures by the break-flash of the signal wires, embodying results of an investigation at the Home Office experimental station at Eskmeals, has been issued. The report is supplementary to that on the same subject issued last year (see ELECTRICAL ENGINEERING, February 4th, p. 45; May 6th, p. 197, and September 2nd, p. 362, 1915), and its main object is to define the precautions necessary for the bare-wire signalling system to be rendered safe.

A number of bells were experimented with and the effect of varying numbers of cells was studied, and the fact is emphasised that with the usual type of bell and magnitude of battery at present employed, nearly every break-flash that occurs when the bare signal-wires are separated would ignite a mixture of firedamp and air containing between 7·5 and 9·5 per cent. of methane were such a mixture to surround the wires at the time.

Several patterns of relays were examined in a similar way, and it was found that relays, although not requiring for their action so great a battery power as bells, have, owing to their higher inductance, a lower "igniting current" at which the break-flash on the signal wires becomes dangerous. At the present time, with few exceptions, the battery power used on relays is in excess of that sufficient to give a dangerous break-flash at the signal wires. The commonest kinds of relays are dangerous when used with a battery of more than 4 wet Leclanché cells, or with any current in excess of the current given by such a battery.

The general theory regarding the working of trembler bells is gone into by the aid of oscillograms showing the gradual growth of the current after the "make" and the fact that its cessation is not instantaneous at the "break."

During the growth of the current the effective voltage is increasing also, until it reaches the battery voltage, while the resistance of the circuit remains constant. When, however, the metallic circuit is broken, either at the trembler of the bell or at the signal-wires, the resistance is suddenly increased. The electro-motive force of self-induction, tending to maintain the decreasing current, therefore rises and may become many times greater than the original (battery) voltage of the circuit, and is sufficient to cause a discharge through the small air-space which at the first instant separates the ends of the metallic circuit. The incandescent particles of metal and air which constitute the flash act for an instant as a conductor and a momentary electric arc (that is, an arc of very short duration) is established.

It will be apparent that a flash can only occur on breaking circuit at the signal-wires if the trembler contacts at the bell are closed at that moment. The greatest flash that can occur at the signal-wires is, however, no less than that which occurs

at the bell; possibly the flashes at the bell may cause ignition more readily owing to their greater frequency in the same place.

It is stated that the igniting power of the flash has been found to depend upon its energy $\frac{1}{2}Li^2$ (when L = the inductance of the circuit and i = the current to be broken) for a slow break from the circuit or Li for a rapid break. One factor that can prevent ignition is therefore the use of high resistance windings and high resistance batteries.

Regarding the mechanical efficiency of bells, it is stated generally that so far as the minimum ringing current is a measure of the efficiency of a signalling bell, the best results are obtained with a low tension on the armature spring. The rate of ringing for a given current is over a long range independent of the tension on the armature spring or the length of the air-gap, though the most rapid rates of ringing are obtained with very low or very high tensions. The ringing force, as estimated by measuring ballistically the energy of the blows given by the hammer, is practically independent of the tension on the armature spring or the length of the air-gap, and is most affected by the distance of the hammer from the gong.

On the whole, therefore, it would appear to be advisable to use as light a spring on the armature as will suffice to maintain good contact at the trembler in readiness to ring and to return the armature to its first position after the ringing blow has been given. Any slight sacrifice in the rate of ringing or loudness of sound that may be caused by using a light spring on the armature is more than compensated for by the fact that the bell can be actuated by a small current.

As regards the electrical efficiency, it was found that with a given battery voltage the ringing power of a bell varies inversely with the resistance of the circuit. It is not possible, however, to work with a very low resistance in circuit, since the current is limited both by the kind of battery used and by considerations of danger due to sparking at the bell or point of signalling.

In studying the question of combining safety with efficiency, the conclusion was arrived at that a bell with many turns of wire gives the greatest ringing power per igniting current ampere, and is in fact the "safest efficient" bell (apart from the use of special devices) on a circuit of given voltage and constant resistance. As a general rule the iron cores of mining bells and, in particular, of relays are made too small, and are magnetically saturated too easily. Taking all the factors into consideration, the general conclusion can be drawn that the most efficient mining bells should have bobbins wound with from twenty-five to thirty layers of fine wire, and that the diameter of the core should be between 0·4 and 0·5 times that of the bobbin.

It has been shown, continues the report, that the dangerous nature of the break-flash that occurs when a bell or relay is included in the electrical circuit is in part due to the occurrence of self-induction which, when the circuit is broken, produces momentarily an abnormal voltage. Suitable methods of rendering bells and relays safe, therefore, are such as aim at minimising the effects of the highly self-inductive electromagnetic windings which are the essential features of bells and relays. It is possible, however, to construct good ringing bells and efficient relays without having recourse to special devices for overcoming the effects of self-induction. The chief factor in rendering the break-flash at the signal-wires dangerous is the amount of current available. Given a definite battery power that is not to be exceeded, the resistance of the bell or relay can be so proportioned that the maximum current obtainable on short-circuit does not exceed the "minimum igniting-current" for the system. The required resistance can be obtained either by means of a non-inductively wound coil in series with the magnet coils, or by winding the coils with a high resistance wire.

There are several ways of overcoming the effects of self-induction. The inductance voltage, which may render the break-flash dangerous, is derived from a sudden change in the number of magnetic lines of force in the windings when the circuit is broken and is proportionate to their rate of change. Any device, therefore, which retards the change of magnetism on break of circuit lessens the break-flash voltage. In this respect parallel-winding, copper sleeves, shunt resistances, and tin-foil layers are identical in their action.

In the parallel winding system, two windings on the bobbins are carried in parallel throughout, only one winding is used as the exciting winding for the magnet, the other is short-circuited on itself. When a current is passed through the exciting winding a current is induced in the short-circuited winding, and when the main current is broken the induced current opposes the change of magnetism which causes the electro-motive force of self-induction of the exciting winding, so that the intensity of the break-flash is greatly reduced. As with ordinary single winding, the best diameter for the core of the magnet is between 0·4 and 0·5 times the diameter of the bobbin. A copper sleeve is, in effect, a short-circuited secondary winding. The core-flux is always proportional to the total ampere-turns of both the magnetising coil and the sleeve, and the sum of these can be made to suit any desired rate of decay of magnetism.

A simple method of suppressing the break-flash at any point at which the circuit is to be broken consists in shunting the magnet-coils by a high resistance. The break-flash either at the bell- or relay-contacts or at the signalling-point has now much less igniting power. The shunt resistance provides a path for the extra current from the coils without that current having to cross the break. In choosing the resistance requisite to render the break-flash harmless it must be borne in mind that the resistance of the magnet coils is proportional to the number of turns of wire, whereas the inductance, which mainly determines the value to be given, is proportional to their square. The most satisfactory method of determining whether a suitable value has been given to the shunt resistance, as it is also the best method of determining the efficiency of any anti-sparking arrangement, is to test the igniting power of the break-flash in an explosion chamber with the circuit arranged as in practice.

Another method of reducing a break-flash is to shunt the break itself by means of a resistance high enough to reduce the circuit current, which is never completely broken, to the desired minimum. In the case of signalling bells or relays actuated by short-circuiting bare wires at any point along a roadway, this arrangement is not to be recommended, for although sparking at the trembler of the bell or at the contacts of the relay can be reduced in this way, the inductance voltage is transmitted through the shunt to the signalling-point, and a dangerous break-flash may be produced there.

With regard to current supply, primary batteries consisting of wet Leclanché cells form the usual source of current. Such cells have a voltage about 1·5 and a resistance of about 3 ohms. Dry cells of the Leclanché type also have a voltage about 1·5, but their resistance may be less than 0·1 ohm.

Secondary batteries have a voltage on open circuit of a little over 2, and their resistance may be as low as 0·01 ohm. Generators and transformers differ from secondary cells chiefly in having self-induction; their resistance may be even lower than that of a central battery of secondary cells of the same terminal voltage. An objection to the use of transformers is that, in the event of failure of the insulation between the primary and secondary windings, the pressure of the power circuit might be transmitted to the signalling circuit. A central battery or generator system is advantageous from the point of view of simplicity of subdivision for different circuits, but such systems require precautions to be taken to avoid heavy currents being obtained on giving a signal; and, from what has been said regarding the necessity of limiting both the amount of current in the circuit and its inductance, if the danger of ignition of inflammable gases at the signal-wires is to be eliminated, it will be realised that the advantage so far as safety is concerned lies with the wet Leclanché primary battery as the source of current.

The general conclusions in the report are summed up as follows:—

(1) As a result of our investigations we are satisfied that the bare-wire system of electrical signalling as commonly employed can be rendered quite secure from any danger of the ignition of inflammable gases by the break-flash at the signal-wires or at the contacts of the signalling instruments.

(2) In order to procure safety it is necessary, in the first place, to limit the battery power that is to be employed on any one circuit; and, in the second place, to ensure that the signalling instrument, whether bell or relay, shall comply with certain requirements.

(3) The present statutory voltage, 25, sets a reasonable limit to the battery power provided that wet Leclanché cells be used. Systems in which the battery used consists of dry primary cells or of secondary cells, or in which continuous or alternating current generators are employed, could be rendered safe if, in addition to the use of "anti-sparking" devices embodied in the signalling instruments, sufficient non-inductive resistance were permanently included in the bell circuit.

(4) The signalling instruments, bells or relays, should have flame-tight covers, and must be so constructed that when included in a circuit with a battery at 25 volts the break-flash produced when bare signal-wires are separated after giving a signal is incapable of igniting an 8 per cent. methane-air mixture. There is no difficulty in constructing either bells or relays to conform with these requirements.

Association of Mining Electrical Engineers.—At the annual general meeting on October 7th the report and accounts for the year to June 30th, 1916, were adopted. There are now nine branches of the Association, but in consequence of the large number of members engaged with the Forces, the examinations were not held. Similarly, in consequence of the war, the operations of the Association have been, to a certain extent, restricted, but a considerable amount of work has been accomplished. The result of the ballot for the election of President, two Vice-Presidents, and Treasurer resulted as follows:—President, Mr. Matthew Brown (Edinburgh); Vice-Presidents, Mr. R. Hood Haggie (Wealdstone) and Mr. G. Stephen Corlett (Wigan); Treasurer, Mr. C. F. Jackson (Bedworth). The prizes for Papers read during the session were awarded as follows:—First prizes of £2 each: H. T. MacKinnon, "Some Coal-Cutting Difficulties"; H. Elliot, "Electrical Plant at Frickley Colliery"; Second prizes of £1 each: Chris Jones, "Static Transformers"; T. Anderson, "Some Electrical Troubles and their Remedies"; R. A. Sheldon, "Electricity as a Haulage and Winding Power in Mines"; R. Devine, "Unusual Breakdowns in Colliery Plant." There was an excess of receipts over expenditure for the year of £146, and after deducting the accrued loss to date there is a balance for the year of £59 16s. 10d.

The Institution of Electrical Engineers.—With the exception of November, the arrangements for the session of the Institution are for monthly meetings instead of fortnightly. In addition to the eighth Kelvin lecture, which is to be delivered on Nov. 9th, the following Papers have so far been arranged for:—Nov. 23rd.—"The Parallel Operation of Electric Power Stations," by J. S. Peck; Dec. 14th.—"Colonial Telegraphs and Telephones," by R. W. Weightman. Jan. 11.—"Principles Involved in Computing the Depreciation of Plant," by F. Gill and W. W. Cook. The Papers to be read at the meetings in February, March, and April will be announced later.

The Brighton Gas Scheme.—According to the local papers the adjourned debate upon the proposal of the Electricity Committee to enter into a contract with the British Coalite, Ltd., for a supply of gas to be used for the generation of electricity, has been further postponed. We referred to the matter on page 369 of our issue of September 28th, when it was before the Corporation for the first time and when the consideration of it was postponed until the October meeting.

ELECTRICAL CARGO HANDLING MACHINERY

IN his "James Forrest" Lecture delivered on Tuesday before the Institution of Civil Engineers, Sir John Purser Griffith dealt with the development of appliances for handling raw materials and merchandise at ports and other centres of traffic. Although he did not enter to any extent into the controversy between electrical and hydraulic methods of cargo handling, he made several references to electrical apparatus of this nature. Messrs. Coy, for example, in reconstructing one of their wharves at Erith, are recorded to have erected five electric luffing cranes fitted with grabs for coal handling. An interesting method of one unloading in use on the American lakes, which is eminently adapted to electric driving, is described in the Hulett system.

The machines consist of a movable crane or gantry, travelling along tracks parallel to the waterway, and spanning any desired number of railway tracks. This gantry carries two girders at right angles to the face of the dock. Along these girders a trolley or carriage, carrying a walking frame, travels backwards and forwards. At the outer end of this beam there is a vertical leg, at the lower end of which is the scoop, or grab, having a capacity of from 3 to 17 tons. This leg is hung on trunnions, and can be rotated in either direction. By means of hoisting mechanism the walking beam is made to oscillate up and down, carrying the leg and grab down into the vessel's hold, and up again on to the quay. These machines are primarily designed for handling ore from the ship to the railroad car direct, but when it is necessary to store the ore for a length of time in stock piles, the crane or gantry is provided with a cantilever extension, running back at a sufficient elevation to clear the piles of ore. In working the unloader, the trolley or carriage runs out on the girders, the outer or water end of the walking beam is brought down till the bucket-carrying leg enters the hatch, and the grab rests on the ore in the hold. The grab is then closed, the leg raised, and the trolley brought back into a position from which the ore can be dumped through a shoot into the railway cars beneath, or, after running up the cantilever extension, on to the stock pile. The operator controlling all the motions of the machine, except moving along the dock, stands in the leg immediately over the grab, going down through the hatch with it, and watching the operations of the grab very closely. By means of the rotating trunnion, the operator is able to make the grab reach all the ore in the vessel. The wide open spread of these grabs is from 18 to 20 ft. These machines have removed, without trimming, 95 per cent. of the cargo of a modern vessel, with a minimum rate of unloading of 200 tons per hour, and a maximum of 680 tons.

Another interesting plant is at work at Fairport, Ohio, and consists of six fast unloading electric trolley grabs, delivering ore from the ship either to rail or store. Five-ton grabs are used, and 10,000 tons of ore have been discharged in 9 hours.

In connection with large electric cranes, Sir John called attention to the 100-ton electric crane in the Port of Dublin. Before its erection, in the year 1905, he continued, it was no uncommon occurrence for heavy loads to be sent round to Belfast instead of being landed in Dublin. The crane is of the hammer type, all the weight of the crane and load being carried by the crane post to a bearing on the ground-level, the overturning moment being taken up by a four-leg trestle frame, with horizontal rollers and roller path at the top of the frame. The crane is capable of lifting loads up to 100 tons at a radius of 75 feet. An auxiliary lift is provided for loads under 20 tons, working to a maximum radius of 80 feet. The test load of the crane was 150 tons. Loads between 50 and 100 tons can be raised at the rate of 5 feet per minute, and below 50 tons at the rate of 10 feet per minute with the main hoist. Loads below 20 tons can be raised at the rate of 20 feet her minute by the auxiliary hoist, and the crane can make a complete revolution with any weight in 8 minutes.

Dealing with more general goods handling, he remarks:—"One of the best examples of handling goods traffic of a general character which I have seen is at the Lancashire and Yorkshire Railway, Oldham Road Goods Station, Manchester, where a very complete system of overhead electric cranes deals with all classes of traffic, and electric motor-trucks are used on the platforms to supplement the cranes for taking goods from one portion of the shed to another. The arrangements for handling, sorting, and delivering the goods are about the most perfect which I have met with, and are worthy of study by those interested in this most important economic problem."

London Electrical Engineers (T.F.).—The following are appointed Second-Lieuts. on probation, dated October 28th:—Sergeant F. Goble, Sergeant R. Francies, and Acting Lance-Corporal C. S. Silva.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published October 26th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

13,904/15. **High-frequency Alternator.** British Thomson-Houston Co. (*G.E. Co., U.S.A.*). A high-frequency inductor alternator having an armature winding carried in slots between teeth on the stator core and a rotating inductor having a number of poles. The width of the stator teeth and rotor poles is such that as the inductor rotates the number of rotor poles opposite any stator tooth alternates between $\frac{n+1}{2}$ and $\frac{n-1}{2}$ where n is any odd integer greater than 1.

13,912/15. **Power Transmission Gear.** A. H. Neuland. An electrical power-transmission apparatus of the inductor type, having an armature provided with a winding and a rotating-field element in inductive relation therewith composed of two relatively rotateable members, producing by their relative rotation a magnetic field having an angular velocity differing from that of the field element so that when the field is in synchronism with the armature, the field element is caused to rotate at an angular velocity different from that of the armature.

14,216/15. **Commutation.** M. Walker. Divided brushes are used on one or more brush arms, the parts of which are connected to a magnetising coil, so that in the event of uneven distribution of the current under the divided brush a relay is actuated controlling the excitation of the commutating poles.

10,554/16 (*101,614*). **Cable Joints.** C. Vernier. Joint boxes, which can be filled with compound without risk of inclusion of air pockets. Baffle plates are mounted in the joint sleeve so as to divide it into two or more compartments, and the filling with insulating compound is effected by pouring into one of the compartments and causing the compound to flow into the other through holes, slots, or insulating tubes in the baffle plates. The compound is thus caused to flow in one direction only, driving the air before it.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Dynamos, Motors, and Transformers: Neuland [Dynamos] 14,377/15; Martin [Dynamos] 18,137/15.

Electrometallurgy and Electrochemistry: Hunt [Electrolytic production of cuprous oxide] 14,310/15.

Heating and Cooking: Heller [Cooking utensils] 14,405/15; Sayers [Heating and cooking devices] 17,366/15.

Incandescent Lamps: British Thomson-Houston Co. (*G.E. Co., U.S.A.*) 14,209/15.

Instruments and Meters: Costello [Electric contact thermometers] 16,466/15.

Switchgear, Fuses, and Fittings: Wynne [Switches] 16,395/15.

Miscellaneous: Blackmore [Indicating and lighting systems] 14,145/15; Jones [Arc soldering] 14,468/15; Prentice [Mounting of electrical apparatus in frames or cases] 14,533/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Ignition: L. Bignon and J. C. Rousset [Automatic timing of magnetos] 13,820/16 (*101,712*).

Switchgear: British Westinghouse Elect. & Mfg. Co. [Circuit breakers] 14,163/16 (*101,720*).

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, &c.: Siemens-Schuckertwerke [Compensating windings of three-phase machines] 9,638/08.

Incandescent Lamps: Deutsche Gasgluhlicht A.G. [Tungsten filaments from which the carbon is removed by sintering] 15,510/07.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

ANSWERS TO No. 1,513.

What strength of pull in pounds can I obtain from the average electric light system, with a solenoid? I require the magnet of the solenoid to move ½ in.; how should such a solenoid be made?

The first award (10s.) is given to "L. B." for the following reply:—

A solenoid design giving a pull of approx. 600 lb. at half-an-inch stroke is shown in Fig. 1, the current taken being only 1·18 amps. momentary on 200-volt circuit, so that it is well within the capacity of "the average electric-light system." It is to be particularly noted that the formula given is not the original Maxwell's law, which law only relates to the force required to separate two plungers of a solenoid that are perfectly joined magnetically, and if utilised to calculate the pull of an ironclad solenoid an entirely erroneous pull will be obtained that is not in keeping with actual tests.

The pull in kilograms of an ironclad solenoid with air gap in centre, which is the position of maximum pull

$$= A\left[\frac{\theta(IN - An)}{981\,L} + \left(\frac{IN}{3951\,g}\right)^2\right]$$

n = The loss of ampere turns required to keep the plunger saturated, and varies directly with the cross-sectional area of the plunger and inversely to the length of the solenoid. Using a soft steel plunger, a flux density "B" of 20,000 lines per sq. cm. is required to saturate, and for this particular design approx. 100 ampere turns per sq. cm. area of core are necessary to accomplish this.

θ = The magnetising force due to winding only at centre of solenoid for 1 cm. of length, and varies with the thickness and length of winding.

In general, $\theta = 2 - \frac{r}{1{\cdot}07 \times L} = 1{\cdot}766$.

The force also to be taken into consideration is the attracting pull between plunger and fixed core.

Plunger diam. = 2½ in. = 6·35 cms.

A = Area of Plunger = 31·7 sq. cms.

g = air gap = 0·5 in. stroke + ⅛ in. gap when closed = 1·59 cms.

r = mean radius of winding = 2¾ in. = 7 cms.

L = Length of coil winding = 11·0 in. = 28 cms.

I = Amperes.

N = Number of turns in winding.

For 200-volt circuit a suitable winding consists of 35 lb., *i.e.*, 6,600 turns of 0·036 in. diam. and 35 lb., *i.e.*, 8,400 turns of 0·032 in. diam. single cotton-covered wire. Jap paper inserted between each layer of wire, the length of each layer being 11·0 in., leaving ¼ in. creeping surface at each end. Coil resistance at 20° C. is 170 ohms., and current taken is 1·18 amps.

Then the pull in kilograms

$$= 31{\cdot}7\left[\frac{1{\cdot}766\,(17700 - 31{\cdot}7 \times 100)}{981 \times 28} + \left(\frac{17700}{3951 \times 1{\cdot}59}\right)^2\right]$$

$$= 282.$$

Therefore pull in lb. = 620, and work done = 310 in. lb. The weight of plunger 10·3 lb. subtracted gives a nett pull of 610 lb. Practically the total reluctance is in the air gap (the permeability of air "μ" being 1). Then

$$B = \frac{0 \cdot 4\pi \times 17700 \times \mu}{1 \cdot 59} =$$

14,000 gausses, which is good practice.

With such a small stroke the magnetic leakage will be negligible.

It is interesting confirmation of above that this design of magnet, except that a taper plunger was used to allow for magnetic leakage with larger air gap, has actually been made and tested at 2 in. stroke giving 122 lb. pull. *i.e.*, 244 in. lb. The flux density being lower, plunger not saturated, and therefore not so efficient. The outer diameter of coil is 8 in., and area of outside surface neglecting ends = 282 sq. in. The watts per sq. in. equal 0·84, which is too high for continuous working. By letting plunger operate a small switch an economy resistance could be inserted, reducing current to a much lower value after lifting. The maximum watts on coil, continuously, should not exceed 0·5 watts per sq. in. An allowance of $\frac{1}{8}$ in. in air gap is for a brass washer to prevent sticking when closed. The tube of bobbin should be of brass or copper $\frac{1}{8}$ in. in thickness, and, besides forming a support for coil and guide for plunger, limits the self-induction when opening circuit. A discharge resistance is unnecessary. The outer yoke can be either cast iron or steel. The working density for steel is 13,000, and for ordinary cast iron 8,000 gausses. The fixed core is of soft steel screwed into top plate. An air vent should be provided in core. A little lessened pull would result as the coil became warm.

The second award (5s.) is made to "Control," who writes as follows :—

The maximum current which can be taken from an ordinary lighting circuit at 220 volts is 5 amps., but a solenoid designed for this would give a pull out of all proportion with the $\frac{1}{2}$ in. stroke required. In the following calculations a current of 0·25 amps. has been fixed on as giving a suitable pull, and the method shown will enable the questioner, if necessary, to design a larger solenoid. With 0·25 amps. the solenoid will require to have a resistance of 880 ohms hot, a current density in the wires of 1,450 amps. per sq. in.—which is suitable for 1-hour rating—will give a wire of 0·0148 in. diam. bare (28 SWG), 0·021 in. diam. over single cotton covering. Assuming a plunger 2 in. diameter, the inside diameter of coil will be $2\frac{1}{2}$ in., and for the best proportion of coil the outside diameter should be twice the inside diameter—that is, 5 in.; this gives a mean length of

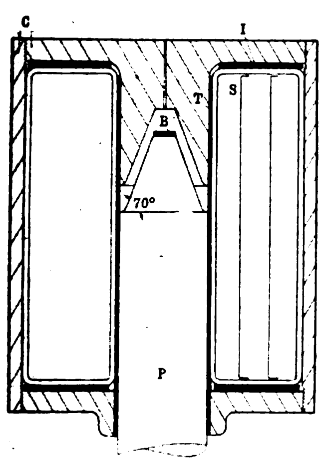

Fig. 1.

C. Wrought Iron Case and Ends.
T. Brass Tube.
B. Brass Pad.
S. Shunt Coil insulated all over with mica plate and taped.
I. Packing Pieces of Insulation.
P. Plunger.

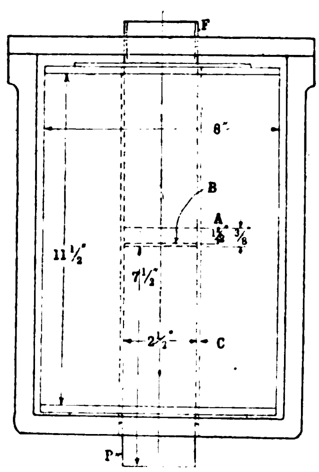

Fig. 2.

B. Brass Washer.
C. Thick Copper Tube.
F. Fixed Pole.
A. Air Gap.
P. Plunger.

turn of 11·8 in., and therefore, as 0·0148 in. diam. wire has a resistance of 175 ohms hot per 1,000 yards for a temperature rise of 75° F., air temperature 60° F., the number of turns in the coil will be—

$$= \frac{880 \times 1000 \times 36}{175 \times 11 \cdot 8} = 15{,}300.$$

If this wire is wound fairly regular, 1,900 turns can be got in per sq. in., and, allowing for two layers of empire cloth to divide up the coil, the area per coil side will be 8·5 sq. in., and depth of coil 6·8 in.

The ampere turns put on coil are 3,830. Allowing 15 per cent. of this for the iron and leakage, 3,300 ampere turns will be left for the air gap, and for this particular value the best results will be obtained—that is, the flux density in mild steel plunger will be run up to about 13,000 C.G.S. lines—if the top of plunger is tapered 70° as shown on sketch. Allowing for brass pad on top of plunger to prevent core sticking, the actual gap between the tapered faces will be 0·22 in., giving density in C.G.S. lines in gap as $\frac{3300}{0 \cdot 8 \times 0 \cdot 22 \times 2 \cdot 54} = 7{,}300.$

The area of top of plunger carrying full density and allowing for fringing is 4·7 sq. in., and therefore total pull

$$= 57 \cdot 7 (0 \cdot 73)^2 \times 4 \cdot 7 = 144 \text{ lb.}$$

This is the pull at right angles to the tapered face, but as it is the pull in the vertical direction which concerns us, the vertical component of the pull must only be considered, and this is 47 lb. The plunger itself has a weight of about 7 lb., so that the nett pull will be 40 lb.

For mechanical reasons the outer case should be made $\frac{5}{16}$ in thick; this will give a density in C.G.S. lines of about 6,000. The endplates should be made $\frac{1}{2}$ in. thick, with the exception that at the bottom plate, where the flux crosses over to the plunger through the thickness of brass tube, it should be thickened up to $1\frac{1}{4}$ in. at the least, giving a density of not more than 4,000 C.G.S. lines; this will keep down the loss in ampere turns at this point to a minimum.

As the solenoid is highly inductive, the switch controlling it should be suitably designed and provided with a non-inductive discharge resistance. The general arrangement of the apparatus is shown in Fig. 2.

THE ELECTRICAL INDUSTRY AND EXCESS PROFITS

THE announcement is made that an application of the British Electrical and Allied Manufacturers Association to the Commissioners of Inland Revenue for an increase in the statutory percentage of profit allowed by the Finance Acts for the purposes of assessment for excess profits has been considered. The application was in respect of manufacturers of :—Electric generators of current for commercial purposes, electric motors for same, electrical switches or controllers for electric lighting or power, electric arc lamps, and/or incandescent lamps, electric cooking stoves and/or radiators, electric meters for measuring or indicating electricity for light or power, electric transformers for lighting or power purposes and electric lamp-holders.

In accordance with the terms of the Act the Inland Revenue Commissioners referred the application to the Board of Referees, who have decided that the statutory percentage in question shall be increased from 6 per cent. to 7 per cent. in the case of a business carried on or owned by a company or other corporate body and to 8 per cent. in other cases.

RESISTANCE UNITS

A PRICE-LIST from the Westinghouse Electric and Manufacturing Co., Ltd. (Trafford Park, Manchester), gives particulars of a standardised series of resistance units composed of wires embedded in cement round a central tube fitted with terminal contacts fitting into suitable holders. A very large number are listed of resistances ranging from ·033 to 3,300 ohms, and the continuous as well as the intermittent current carrying capacity are given in each case. These units can be built up with a variety of forms, and can be used for motor starters, instrument resistances with telephone and telegraph apparatus, as arc lamp resistances, with lightning protection apparatus, etc., and their special advantages are that they possess large heat absorbing capacity with a maximum radiating surface; while the resistance metal is protected against corrosion and mechanical damage. The interchange of units is also easy and the connections simple. The material of which they are made has a practically negligible temperature coefficient.

B.E.A.M.A. Membership: Important Accessions.—The B.E.A.M.A. announces that the following firms have been elected members of the Association :—Ashton Frost & Co. (Blackburn); Bever Dorling & Co. (Bradford); Buckley and Taylor (Oldham); Clayton, Goodfellow & Co. (Blackburn); Davy Bros. (Sheffield); Fullerton, Hodgart & Barclay (Paisley); Galloways (Manchester); Glenfield & Kennedy (Kilmarnock); Lilleshall Co. (Salop); Marsdens' Engines (Heckmondwike); Newton Bean & Mitchell (Bradford); Pollit & Wigzell (Sowerby Bridge); Robey and Co. (Lincoln); Scott & Hodgson (Manchester); S. S. Stott & Co. (Haslingden); Simplex Conduits (Birmingham); Tyer & Co. (London), Woodhouse & Mitchell (Brighouse); Yates & Thom (Blackburn).

LOCAL NOTES

Cheltenham: *Street Lighting.*—There having been considerable complaints against the action of the authorities in suppressing the whole of the public lighting, the Borough Electrical Engineer has prepared a scheme for dealing with those streets in which electricity is used in a manner which will assist the public on the one hand and not contravene the Defence of the Realm Act on the other. The idea seems to be to install smaller candle-power lamps and to subdue the lighting suitably; whilst arrangements have been made for all the lights to be switched off on information being received that hostile aircraft are coming across the North Sea. Furthermore, it is the intention to turn out all the lights every night at ten o'clock. The Electricity Committee has already sanctioned the scheme, which will come before the Corporation next week.

Glasgow: *Plant Capacity.*—The recommendation that the Corporation should proceed with a portion of the Dalmarnock power station, mentioned on page 403 of our last issue, has been adopted by the Corporation. The scheme is for sufficient plant to be installed to meet the demands for the winters of 1917, 1918 and 1919.

Newport (Mon.): *Electricity Deficit.*—The accounts of the electricity undertaking for the past year show a deficit of £983. Two years' war bonus paid to the employees has been charged to the accounts for the year, otherwise the undertaking would have shown a fair profit.

Tynemouth: *Bulk Supply.*—The Corporation, which, in the ordinary course, obtains most of its supply in bulk from the power companies, has found it necessary to put the old steam plant into operation again on account of the demands upon the undertaking.

Worksop: *Electricity Staff.*—The question of the electricity staff has again been a matter for consideration. A special committee, which was appointed recently to investigate the adequacy or otherwise of the staff now engaged, reports that in its opinion the staff is the minimum which could be employed to carry on the work efficiently. It was stated in the Council a short time ago that the understanding when Mr. Crowther, the Borough Electrical Engineer, joined the Army, was that an assistant to the Engineer-in-charge would not be necessary. The Special Committee now endorses this opinion, but, as we pointed out a short time ago, an assistant has been found necessary. The Chairman of the Lighting Committee, who tendered his resignation in consequence of certain suggestions in connection with the appointment, has now withdrawn it and has been unanimously re-appointed.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The Sydney Council require 33,000-volt three-phase high-tension switch-gear. The specification and form of tender may be consulted at 73, Basinghall Street, E.C. Tenders to Town Clerk, Town Hall, Sydney, by January 8. This information is, of course, only of value to firms who can cable agents.

Newport (Mon.).—The Electricity Committee require rotary converters and switch-gear. Borough Electrical Engineer, November 6.

New Zealand.—It is understood that the Electrical Department of the Government is investigating a site for a new power station in the North Island.

Miscellaneous

Australia.—The New South Wales Government Railways and Tramways Department requires for its Yarra Street Power House, Newcastle, a 50-ton electric overhead travelling crane. Tenders by January 3. Local representation is necessary. The specification may be consulted at 73, Basinghall Street, E.C.

Egypt.—The specification and form of tender for electric lamps and fans required by the Alexandria Postmaster-General may be obtained at the London offices of the Egyptian Government representative, Sir A. L. Webb, K.C.M.G., Queen Anne's Chambers, Broadway, Westminster, S.W.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £141 to £144 (last week £145 to £146).

Bayonet Key Switch Holders.—We understand that the Electrical Supplies Co. ("The Lighthouse," 233, Tottenham Court Road, W.C.) has brought out a patent key switch holder, with shade carrier and cord grip, and are carrying extensive stocks at their London stores. In view of the abnormal shortage of key holders and the extreme difficulty of obtaining supplies, this information will probably be of interest to our readers.

Pope Lamps.—We have received from Pope's Electric Lamp Co., Ltd. (Hythe Road, Willesden), a booklet entitled "My Life." This features the experiences of their mascot, "The Elasta Man." In the booklet we see Mr. Elasta in all sorts of situations, each situation pointing a moral to the virtues of "Pope Elasta British-made Wire Lamps." We understand from Messrs. Pope's that the use of this mascot has drawn considerable attention to the merits of their manufactures, and the booklet cannot fail to interest not only electrical men but also the general public. Messrs. Pope's offer to supply contractors with printed copies of this booklet upon request

APPOINTMENTS AND PERSONAL NOTES

The Council of the Institution of Electrical Engineers have elected Professor George Carey Foster, F.R.S., Past President, to be an honorary member.

There were 106 applications for the position of Borough Electrical Engineer at Wigan, and the following short list has been prepared:—R. Owen, deputy engineer, Leeds; E. G. Love, deputy engineer, Halifax; H. Webber chief electrical engineer, Keighley; H. J. L. Bull, acting engineer, Wigan; J. Collinge, station superintendent, Salford; J. B. Hudson, deputy engineer, Bootle; R. H. Lee, assistant engineer, Stockport; and E. Moxon, deputy engineer, Blackburn.

A general manager is required for the Lahore Electric Supply Co. Applications are invited only from full members of the Institution. See an advertisement on another page.

Particulars of a number of appointments appear in our advertisement pages.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Dartmoor Electric Supply Co.—The capital of this Company is to be reduced from £4,000 to £2,000. An application will be made to the Devonshire County Court, Exeter, on Nov. 6th.

Dick Kerr & Co.—At the annual meeting last week the report and accounts given in our issue for October 26th were adopted. Mr. C. T. Cayley, the chairman, said that the work undertaken by the Company during the past year had been of greater magnitude than the directors anticipated twelve months previously. Both the manufacturing and contract departments were dealing with a larger turn-over than ever before in the Company's history, a fact greatly to the credit of the depleted staff. In connection with the controlling interest in the shares of Messrs. Willans & Robinson which the Company has obtained, reference was made to the close relationship which has existed between the two concerns for many years, and satisfaction was expressed at the opportunity for cementing that relationship by a closer combination of working interests. At a time when absenteeism is much in the public mind, it is not without interest to note that the time lost by the workers at the Company's Preston works from all causes, illness included, during the past twelve months was less than 1·4 per cent.

Drake & Gorham.—The report for the year to June 30th shows a net profit of £8,527. After paying 4 per cent. on the ordinary shares, and writing down goodwill by £3,000, there is a carry forward of £2,150. Although the net profit is below the pre-war average it is more than twice that in the previous year.

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Cheques to be made payable to THE KILOWATT PUBLISHING CO., LTD., and to be crossed LONDON COUNTY AND WESTMINSTER BANK (Temple Bar Branch).

SUMMARY

MR. A. F. BERRY has designed a "Tricity" flame fire which aims at imitating the appearance of a coal fire (p. 422).

MR. G. WILKINSON, Borough Electrical Engineer at Harrogate, has designed a by-product steam boiler in which the coal is distilled, and the coke obtained used in the boiler furnace. The gas is also used in the furnace. The permission of the Ministry of Munitions is being asked for to manufacture the boiler as a matter of urgency in the national interest (p. 422).

THE new three-phase generating station of the Walsall Corporation was opened last week. A full description of the plant appears on p. 423.

A LETTER dealing with the question of national electric power supply appears on p. 424.

ILLUSTRATED articles deal with instruments, transformers and primary cells (pp. 424 and 425).

THE calculation of resistances forms the subject of a question on p. 425.

AMONG the subjects of specifications published at the Patent Office last Thursday are incandescent lamp manufacture and heating apparatus. An electrical engine starter patent is opposed. An important patent connected with printing-press driving expires this week (p. 426).

THE arrangements for the meetings of the Institution Local Sections next session are now almost complete (p. 426).

THE Electric Vehicle Committee is urging electrical manufacturers and automobile makers to take the necessary steps to place the manufacture of electric vehicles in this country on a substantial basis (p. 427).

A NUMBER of further decisions have been announced regarding the percentage of profit to be allowed before assessment for excess profits. In all cases dealt with so far affecting the electrical industry the results have been favourable (p. 428).

THE Dublin Corporation is to be asked to appoint an outside expert as engineer and manager of the electricity undertaking for three years.—Belfast electrical contractors are again urging the construction of a new power station in order to deal with the demands for supply which at present cannot be met.—The Clyde Valley Electric Power Co. has opened a new power station at Cambuslang (p. 429).

ADDITIONAL plant is required at Sheffield, tram-cars at Rotherham, mains at Stafford, and sub-station plant at Aberdeen. The Durban Corporation requires a 3,000-kw. steam turbo-alternator (p. 429).

THE A.E.G. ELECTRIC CO.
Sale to Dick Kerr & Co.

IT is announced that the business of the A.E.G. Electric Co., the English branch of the A.E.G. of Berlin, has been sold by the controller appointed some time ago by the Board of Trade, to Messrs. Dick Kerr & Co. It is understood that the reason for the delay in winding-up the company under the terms of the Trading with the Enemy Acts was due to the large number of important contracts which were in hand for British firms engaged on Government work.

Gradually, however, the assets of the company have been transferred to the Public Trustee, and the final sale and wind-up of the company became possible. Meanwhile, the original German staff had been replaced by British workmen who have now been taken over by Messrs. Dick Kerr & Co., together with a number of uncompleted contracts. We learn from the *Times* that it is the intention to shortly wind-up the two other subsidiary companies of the A.E.G. of Berlin, namely, the Electrical Co., Ltd., and the A.E.G. Electric Co., of South Africa.

1st LONDON ENGINEER VOLUNTEERS

ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Ptn. Cmdr. J. O. Cheadle. *Next for Duty.*—Ptn. Cmdr. A. Gerard.

Monday, Nov. 13th.—Technical for Platoon No. 9 at Regency Street. Squad and platoon drill, Platoon No. 10. Signalling class. Recruits' drill, 6.25—8.0.

Tuesday, Nov. 14th.—School of Arms, 6—7. Lecture, 7.15, "The Service Rifle," by Ptn. Cmdr. A. Gerard.

Wednesday, Nov. 15th.—Instruction class, 6.15. Platoon drill, Platoon No. 3.

Thursday, Nov. 16th.—Platoon drill, Platoons Nos. 5 and 6. Ambulance class by M.O., 6.0.

Friday, Nov. 17th.—Technical for Platoon No. 10, Regency Street. Squad and platoon drill, No. 9. Signalling class. Recruits' drill, 6.25—8.25.

Saturday, Nov. 18th.—N.C.O.'s class, 2.30, Co. Cmdr. Castell.

Sunday, Nov. 19th.—Entrenching at Otford. Parade Victoria (S.E. & C. Ry. Booking Office) 8.45 a.m. Uniform, haversacks, and water-bottles. Midday ration to be carried. Railway vouchers will be provided.

Musketry.—For all companies see Musketry Notice Board.

INSPECTION.—The Corps will be inspected by Sir Desmond O'Callaghan on Nov. 25th. Parade 2.20, uniform. A full muster is highly important.

Note.—Unless otherwise indicated, all drills, &c., will take place at Headquarters.

Arrangements for the Week.—To-day (*Thursday*), *Nov. 9th.*—Institution of Electrical Engineers, Eighth Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," by Dr. Alexander Russell. Presentation of premiums, 8 p.m.

Friday, Nov. 10th.—Physical Society, Imperial College of Science, South Kensington, 5 p.m.

Saturday, Nov. 11th.—Chief Technical Assistants' Association, Tavistock Hotel, Covent Garden. Discussion on "Coal and Ash Handling Plant," 3 p.m.

Monday, Nov. 13th.—Institution of Electrical Engineers, Newcastle Section, Armstrong College. Chairman's address by Mr. H. W. Clothier, 6.45 p.m.

Tuesday, Nov. 14th.—Institution of Electrical Engineers, Scottish Section. Chairman's address by Mr. J. K. Stothert, 207 Bath Street, Glasgow, 7.30 p.m.

Institution of Electrical Engineers, Manchester Section, Engineers' Club. Chairman's address by Mr. A. C. McKenzie, 7.30 p.m.

Wednesday, Nov. 15th.—Institution of Electrical Engineers, Birmingham Section, The University. "Some Aspects of Lord Kelvin's Life and Work," by Dr. Alexander Russell, 7 p.m.

Royal Society of Arts, John Street, Adelphi. Opening address by Dr. Dugald Clerk, "The Stability of Great Britain," 4.30 p.m.

Thursday, Nov. 16th.—Greenock Electrical Society, 22 West Stewart Street. "A Criticism of the I.E.E. Rules," by H. Piggott, 7.45 p.m.

Friday, Nov. 17th.—Batti-Wallah Society. Dinner at Victoria Mansions Restaurant, Victoria Street, London, S.W., 6.30 p.m.

Restrictions on Copper Wire Manufacture.—The Minister of Munitions has issued an order prohibiting from November 6th the manufacture of any copper wire or any cable containing copper, except for the purposes of orders under Classes A and B or in connection with any order bearing the identification letters of the Admiralty, the War Office, the Ministry of Munitions, or the Post Office.

ELECTRIC COOKING AND HEATING

MR. A. F. BERRY'S paper before the Association of Supervising Electricians on October 31 was an excellent chat on the subject generally. The two questions that had to be answered to the satisfaction of the would-be user were, he said, "What is it worth to me?" and "What will it cost to instal and use?" In answering the question as to the worth, for instance, of an electric fire, a consumer would take into account first of all his personal benefits, such as monetary and labour savings, convenience and the capacity for rapidly and cheerfully warming an apartment, whilst as to cost, a consumer would have in mind three things—the initial outlay involved, the cost of maintenance and repairs, and the cost of the current consumed. In any discussion as to the relative cost of fuel, it should be borne in mind that the actual cost of cooking, for instance, is similar whether one uses coal or gas or electricity. The real point to concentrate upon was the greater advantages of electric cooking and heating over either gas or coal. One point concerning the heating values of fuel upon which it was desirable to insist was that samples of coal and gas when burned give out widely differing numbers of heat units according to their qualities, but a unit of electricity gives the same amount of heat, all useable every time.

Coming to the question of the saving in cooking by electricity, Mr. Berry pointed out that by coal one must expect to lose from a quarter to one-third in weight of what was put into the oven in the shape of a joint, but by careful oven designing he had found it possible to avoid some 80 per cent. of this waste and, what was more important, it soon became apparent that by suitably designing the oven and its heat controls the ordinary user could readily effect similar economies, at the same time preparing food in a manner immeasurably superior to what had previously been possible. It had been repeatedly and conclusively proved that in ordinary households the cost of cooking a joint, say 10 lbs., with gas, coal or electricity, was of the order of 2d., taking coal at £1 per ton, gas at 3s. per thousand cubic feet, and electricity at 1d. per unit. The advantage in favour of one or other method of cooking due to a specially good handling of a cooker might be of the order of ¼d., nevertheless, the real advantage of electric cooking was the saving in the waste, for he had found it possible to put upon the table from a joint of less than 8 lbs. the same amount of food that had required a joint of 10 lbs. when the older methods of cooking were employed. The saving here was of the order of 2s. in ordinary times, and with present meat prices it was about 3s. The difficulty of impressing these savings upon the ordinary householder was the fact that scarcely anyone took the trouble to weigh a joint before and after cooking. His experience of the cost of many hundreds of thousands of "Tricity" cooked meals led him to the conclusion that it was possible for a good meal to be cooked at a cost of one unit of electricity per person in the case of small households, whilst where the cooking operations were on a larger scale this was reduced to one-half unit per person.

Electrical engineers who did not use electricity in their homes for cooking could never hope to convince others of the full advantages of electric cooking. They were certainly not in a position to express a personal opinion if they had not made use of it themselves. Nevertheless, electric cooking had developed from the stage when it "was done somehow" to the present stage when it "cannot be done without," and curiously enough, his experience was that ordinary users of electric cookers were even more enthusiastic regarding them than many supply engineers and contractors. The reason for this was the improvement in detail apparatus, such as fuses, indicators, contacts, terminals and switches. The use of indicators to show when hot plates, etc., were "on" had been a great help in the direction of economy. Models of the latest forms of combined fuses and indicators were exhibited.

Turning to electric heating, he said it was an unfortunate fact that many who use a four-lamp radiator expect to get from it much more heat that they were entitled to, and lighting and heating by means of lamps would be nearer perfection if, as he hoped would be the case very shortly, it were possible to destroy the monotony of the lamp radiator and at the same time increase its efficiency. An endeavour to imitate as near as possible the coal fire was shown in the "Tricity" Flame Fire, one of which was on view at the meeting. A great deal of the life of a fire was indirectly due to the different refrangibilities of the various vapours and heated air through which the burning fuel was seen and also to the varying degrees of redness caused by the play of the air upon the fuel. The "Tricity" Flame Fire had been designed to give a similar effect.

A BY-PRODUCT STEAM BOILER

AT a time when so much attention is being focused upon the scientific utilisation of coal, an investigation which has been carried out by Mr. G. Wilkinson, chief electrical engineer to the Harrogate Corporation, merits more than passing notice. The facts are as follows:—

The Harrogate Electricity Works are situate about the middle of a 300-acre farm belonging to the Corporation which up to about twelve years ago was used for sewage irrigation purposes. Since that date it has been farmed. This farm is immediately abutting on one of the best residential neighbourhoods of Harrogate, and part of it has been devoted to a successful golf club for the last three or four years. The residue is likely to come into the building market after the war. The large chimney at the electricity works is an eyesore to the estate, and if this is removed it is reasonable to assume that the value of the land will appreciate an average 6d. per sq. yd., which represents over £30,000. In these circumstances the Corporation some time ago requested Mr. Wilkinson to devote attention to smokeless combustion, and as a result of careful investigation and experiment he has been able to design a boiler with the following characteristics:—

1. The coal is distilled, tar and ammoniacal liquor being extracted as by-products.
2. The coke obtained from the coal while incandescent gravitates into the furnace and is there consumed without smoke.
3. The gas, after being denuded of the by-products, is also passed into the furnace under considerable pressure with the necessary air and burns with a smokeless flame until it enters the retort flue, where it is tranformed into radiant heat. This radiant heat is absorbed partly by the retort and partly by the water in the boiler.

Thus very active steaming surfaces are produced not only in the furnace but upon the whole flue surface. On an average it is expected to get from 20 to 25 lbs. evaporation per sq. ft. of heating surface. The boiler is automatically fed with coal, which passes through the various stages of distillation and combustion automatically. It is also expected the boiler will furnish superheated steam by reason of a special arrangement inserted in the boiler itself. The boilermaker's opinion of the boiler is favourable, especially as regards its simplicity and cheapness in construction.

Meanwhile the Ministry of Munitions has been asked for special permission to build the boiler without delay under the plea that an efficient powerful boiler which furnishes by-products is of national interest and will be of utility in the production of raw material used in explosives. When the boiler is built and successfully tested the Corporation will in all probability be quite prepared to put in two boilers in place of a large Lancashire boiler which has recently been sold. Mr. Wilkinson calculates that twice or three times the amount of steam produced by the ordinary shell type boilers per sq. ft. of boiler floor will be furnished by his boiler, whilst due to smokeless combustion no chimney-stack will be required, induced draught fans being employed instead of a chimney-stack.

Perhaps we may quote an expression of opinion by Mr. Wilkinson:—

I am aware there are schemes spoken of for the distillation of coal in large power houses, but under the present methods the capital outlay necessary to provide plant which is now in the market is absolutely prohibitive, having regard to the commercial aspect of the question. Electrical and mechanical engineers as a rule know little of the subject of the distillation of coal while gas engineers who are skilled in the art know little of boiler-house practice. Thus it comes about that there is no plant at present available for coal distillation and steam raising at a reasonable price or of convenient and efficient design. Furthermore, the prevailing idea that coal distillation and steam production can be economically carried out successfully on a very large scale only, will be dispelled when closer attention is given to the problem, provided the power station engineer is wise enough to dispose of his crude products to firms who prepare the various useful commodities therefrom, for which there is a ready and increasing demand. When this possibility is realised there will be less fuss made about "linking up," which is the fashionable subject of the hour, and which is largely based upon the assumption that super-stations, preferably established on the coalfields themselves, are alone able to produce economical results, by-products of coal, and low costs of production.

ELECTRICITY SUPPLY AT WALSALL

THE new generating of the Walsall Corporation at Birchills, which has been necessitated by the development of the electric supply undertaking of the borough to an extent out of proportion to its original resources, is now complete, and the first instalment of plant was inaugurated on Tuesday of last week.

The undertaking dates from 1895, when a supply was first given under a provisional order granted nine years previously. The system originally adopted, upon the recommendation of Mr. Frederick Brown, consulting engineer, was the high tension D.C. system, with rotary transformers in sub-stations, commonly known as the "Oxford" system, which found considerable vogue at the time. The transmission pressure was 2,000 volts, and a direct-fed 105 volt two-wire network was laid down in the central portion of the town. In 1900 two-wire 210-volt distribution was commenced in the outlying districts, and further extensions on the same system were made from then, including the provision of tramway supply, until in 1907, when Mr. A. S. Barnard succeeded Mr. A. Wyllie as Borough Electrical Engineer, the plant capacity had increased from its original figure of 240 kw. to 1,730 kw. and sixteen rotary sub-station transformers were in commission. The next extensions following a parallel history to so many undertakings marked the entry in 1911 of three-phase plant, and a pair of 500 kw. turbo-alternators were erected in the enlarged station at Wolverhampton Street. A commencement was made with the supply of alternating current in the Bloxwich district, and a rotary converter sub-station was opened in Darwall Street. The rapid increase in the demand, however, soon rendered this station inadequate, and Mr. E. M. Lacey, who was called in to report in 1913, pointed out that the most economical course was to erect an entirely new station on modern lines on a more suitable site on the Wyrley and Essington Canal at Birchills, generating at 6,600 volts in conjunction with rotary converter sub-stations feeding a three-wire D.C. network, while large power users were supplied from a high tension system of mains. Work on this new station, which it is now our purpose to describe, was begun in 1914, when Mr. H. A. Howie became Borough Electrical Engineer.

The building, which is the work of Mr. Bruce Dawson, F.R.I.B.A., is of pleasing appearance without undue elaboration, and the group of short metal chimneys which replace the familiar tall brick smoke stacks gives it a distinctively modern aspect. The boiler-house is 74 ft. by 74 ft., and the engine-room, of the same length, is 46 ft. wide. The simplicity of the coal-handling plant is a special feature. This consists of a jib crane, by means of which the coal is carried from canal barges to the receiving hopper of a bucket conveyor by which it can be transported to any part of a large storage yard, and from any part of the storage yard to the overhead boiler-house bunkers, or it can be transported direct from the receiving hopper to these bunkers if required. From the overhead bunkers the coal passes through measuring drums with recording counters and bifurcated chutes to the hoppers of the automatic stokers.

The boiler-house is designed for the accommodation of six boiler units, four of which have been erected. Each boiler unit comprises a water tube boiler with integral superheater, a super-imposed economiser, induced draught plant, a steel chimney of the Venturi type, and a chain grate stoker. The whole of the coal-handling plant, boilers, economisers, mechanical stokers, and pipework, were supplied by Babcock and Wilcox, Ltd. Each boiler unit is designed for a normal evaporation of 26,000 lbs. of water per hour, from a feed temperature of 100 degrees Fahrenheit, entering the economiser, to steam of 185 lbs. per sq. in. pressure, and a total temperature of 636 degrees Fahrenheit. On high duty each boiler unit will raise 30,000 lbs. of steam per hour. The above duties are based on the use of South Staffordshire unwashed slack of an average calorific value of 11,000 B.Th.U. per lb. as fired. The feed pumps are of the centrifugal type, direct driven by steam turbines, exhausting into a boiler feed heater, and were built by G. and J. Weir, Ltd. Each of the two pumps is capable of delivering 8,000 gallons of water per hour against a boiler pressure of 185 lbs. per sq. in.

The engine-house is designed for the accommodation of three steam turbo-alternators, each of 4,000 kw. capacity. Two units have been ordered, but only one has at present been erected. The turbines are of the compound horizontal, impulse type, the first stage being compounded for velocity and the subsequent stages for pressure. The condensers are of the contraflow surface type with rotary air pump ejector, and centrifugal circulating water pump, the pumps being coupled in line and driven by a three-phase motor of 95 b.h.p. The alternators are of the revolving field type, and are designed to generate three-phase current, at a terminal pressure of 6,600 volts between phases, with a frequency of 50 cycles per minute, when operating at a speed of 3,000 revolutions per minute. The full load of the alternators is 5,000 k.v.a., but they are capable also of giving an overload output of 6,250 k.v.a. for a period of two hours. The exciters are of the overhung type, the armatures being mounted directly on the armature shafts. The alternators are cooled by means of air drawn from outside the engine-room through a dry filter and duct, by means of fans fitted on the rotors of the alternators. The turbines and condensers were constructed by Belliss and Morcom, Ltd., at Birmingham, and the alternators by Siemens Bros., Dynamo Works, Ltd., at Stafford.

The E.H.T. switchgear is designed for three generator panels and seven outgoing feeders of 1,500 kw. capacity each. The bus bars are in duplicate and the two sets can be coupled by means of a non-automatic interconnecting switch. The Merz-Price system for generator protection is employed. The system is earthed through an earthing transformer directly connected to the bus bars. The switchgear was made by Messrs. Reyrolle and Co., and is of their iron-clad construction type. Two 500-k.v.a. transformers are provided for the station motor auxiliaries and lighting. These transformers were built by the British Westinghouse Co., as also were the motors for the induced draught fans, etc.

A new system of E.H.T. cables, designed for Callender-Water's earth leakage protection has been laid down by Messrs. Callender's Cable and Construction Co., linking up several sub-stations in various parts of Walsall. At these sub-stations the pressure is reduced to low tension D.C. or A.C. current before distribution to the consumers. The rotary converter plant, consisting of two 500 kw. rotaries and three 250 kw. rotaries, have been supplied by Siemens Bros., Dynamo Works, Stafford.

Five 500 kw. static transformers, and the whole of the E.H.T. and L.T. switchgear for nine sub-stations have been supplied by the British Westinghouse Electric and Manufacturing Company. These transformers are used for various purposes. Two, installed in the Birchills power-station, convert three-phase current from 6,600 to 375 volts for use in motors driving the station auxiliaries. Two others are used to step up 3,300-volt supply from 500 kw. turbo-alternator sets in the old power-station to 6,600-volt supply for use on the new extra high tension distribution system, while a fifth similar transformer is installed to convert from 6,600 to 3,300 volts to feed an existing switchboard and distribution network. All the transformers are of the oil-insulated type, designed with ample overload capacity, and to have equal temperature throughout the windings, and a minimum voltage between adjacent turns of the windings. They are contained in cases constructed of sheet steel electrically welded.

The E.H.T. sub-station switchgear is of the sheet iron cubicle type. The panels are provided with sheet iron doors, giving access to the isolating switches at the top, and a three-pole oil-break switch at the bottom of the panel. The chamber containing the oil-break switch with current transformers mounted above is separated by a horizontal partition from the chamber containing the isolating switches, while this chamber in turn is separated by another barrier from that in which the bus bars run across the top of the board. The entire board is made of non-inflammable materials. The panels are fitted with red and green indicating lamps, ampere meters, contacts for voltmeter and synchronising plugs, and suitable relays affording automatic protection to rotaries and feeders, and in the event of a feeder being cut out through excessive overload, preventing interruption of supply to other feeders. The oil-break switches are of the latest design, of large breaking capacity, and embody all the best characteristics of modern switchgear practice. The low tension D.C. switchboards are of black enamelled slate panels mounted on substantial angle iron framework, and are equipped with the necessary instruments, fuses, switches and automatic circuit breakers.

The whole of the work was carried out in accordance with the specifications and drawings prepared by the consulting engineer, Mr. E. M. Lacey, and it is interesting to note that when complete the output of the new station per unit of floor space will be over four and a half times that of the old station.

CORRESPONDENCE

ELECTRICITY SUPPLY IN GREAT BRITAIN.

To the Editor, ELECTRICAL ENGINEERING.

IN perusing Mr. Williams's letter in ELECTRICAL ENGINEERING of October 12, what occurs to the commercial mind is that although investors in electric power companies are not at present properly protected, the interests of the consumer, the main factor in the case, are not sufficiently kept in view.

How are future benefits of electrical reform to reach the consumer in some Parliamentary areas, notably in the North of England, where two influential intermediary companies, a holding company and a waste heat plant lending company, have intervened between the authorised undertakers and the consumer, and are depleting the revenues of Parliamentary undertakings in the Cleveland and Durham area on the North-East Coast?

This holding company has acquired the power of evading the provisions of the Electric Lighting Acts meant for the commercial protection of the public. It has the means in its own hands of keeping up prices against the consumer. It can divert the whole profits or such portion as it thinks fit from the authorised undertakers to itself or others. It can make the statutory accounts show a state of prosperity or adversity at will. It all depends on the price it charges above or below cost for the bulk supply of electricity which it controls and compels the Parliamentary company to take at its own price. In these circumstances what value are the statutory accounts and what use are the clauses in the Electric Lighting Acts regulating prices and dividends?

By selling practically all its shares in 1906 to the holding company, has not the Parliamentary company, the authorised undertakers, deprived itself of its independent power to carry out its Parliamentary obligations and delegated its rights and powers to others, which is expressly forbidden by Section 11 of the Electric Lighting Act, 1882, and Section 14 of the Electric Lighting Act, 1909?

The scheme of audit of this organisation does not provide an adequate check on the inter-company transactions involved. The Board of Trade auditor has stated that he cannot check certain figures in the statutory accounts, and although the Board of Trade have reported year after year that the authorised undertakers are "undertakes in name only," the Board of Trade do not appear to have the power to remedy what they have condemned.

It is obvious that the commercial aspect of electrical development in the North of England and the consumers' future welfare are absent from the minds of those electrical experts who hold up the North-East Coast as an example of splendid success.

Now that important proposals are before the public, it seems an opportune time that, before further legislation is sanctioned, Parliament should undertake a searching and impartial investigation into the abuses of their Parliamentary powers by the Cleveland group of electric power companies operating on the North-East Coast and elsewhere. They have ignored the Board of Trade for the past ten years, and persisted in their commercial antics in spite of public and private protests in the Press and otherwise.

The Parliamentary company (the authorised undertaker), with a million authorised share capital, has no shareholders other than the directors of the holding company or their nominees. The holding company's directors, as the sole shareholders and directors of the Parliamentary company, vote and pass dividends without the healthy criticism of proper shareholders, re-elect themselves directors, fix their own fees, appoint auditors, and pass all resolutions required of proper shareholders.

The main pofits of the business are not shown in the statutory accounts; they are being diverted from the revenues of the Parliamentary company through the holding company to a waste heat plant lending company, an arrangement by which the plant-lending company is ensured, according to its prospectus, not only ample dividends, but the payment of its plant free of cost. Ten per cent. on their outlay, plus a price for the electricity produced at the borrowers' expense, have been reckoned fair terms to exact from a Parliamentary undertaking that has lost control of itself and is the "authorised undertaker in name only." Thus, an outside agency having neither rights nor obligations under the Electric Lighting Acts is filling its coffers according to its own story, and as shown by its accounts, to pay for its plant free of cost to itself, amounting to hundreds of thousands, out of the revenues of Parliamentary undertakings through the holding company, which also has neither rights nor obligations under the Electric Lighting Acts.

It is certain that, more than ever after the war, every possible economy must be within reach of the industrial and manufacturing community. The improvements in electricity supply and economies in working on national lines which the committee of the Institution of Electrical Engineers will no doubt succeed in bringing about would be shorn of their main value if a powerful organisation be allowed to interpose, as at present, by submarine methods, and prevent the benefits from reaching their proper destination. What will the electrical experts do to help Parliament to grapple with and control this powerful organisation in the North of England before new proposals are put before the Legislature?—I am, &c.,

ANDREW GEMMELL,
A Former Secretary to Electric Power Companies.

Ovingham-on-Tyne,
October, 1916.

INSTRUMENT TRANSFORMERS

A NUMBER of types of instrument transformers for circuits up to 12,000 volts are dealt with in a new illustrated list from the British Thomson-Houston Co., Ltd. (Rugby). The current transformers include several patterns with different styles of insulation, such as an insulated transformer with wound primars transformers with porcelain tube insulation for slipping over cables or with single rod primary, and the compound insulated pattern illustrated in

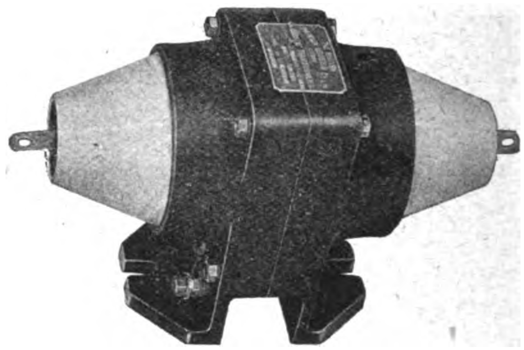


FIG. 1.—COMPOUND INSULATED CURRENT TRANSFORMER.

Fig. 1, with the primary winding assembled between two secondary windings on a laminated core, inside a cast-iron case terminating at each end in a porcelain cone through

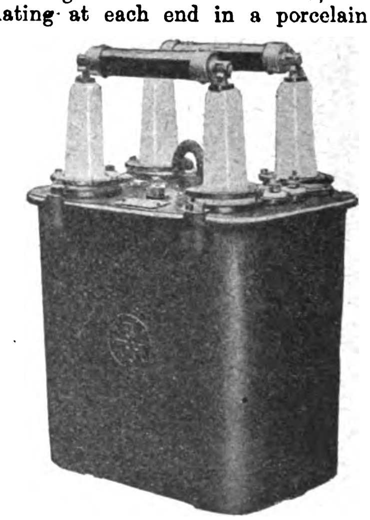


FIG. 2.—OIL-INSULATED POTENTIAL TRANSFORMER.

which the primary terminals are brought. The case and porcelains are filled with insulating compound. Oil insulated current transformers are also standardised and the potential transformers, one of which is illustrated in Fig. 2, are also oil insulated.

Trade with Russia.—An interesting statement of British opportunities in Russia is given in a small pamphlet by Louis Rojansky, published by the Anglo-Russian Translations Bureau, Chiswell House, 133-7 Finsbury Pavement, London (price 2*d*.). All classes of industry are dealt with, and the booklet concludes with a tabular statement of imports to Russia from Germany, Austria-Hungary, and the United Kingdom. Presumably, these refer to the last pre-war year, and it appears that the imports from Germany and Austria into Russia of electric appliances for illumination and transmission of power amounted to £280,300, whilst similar imports from the United Kingdom totalled only £6,500. The respective figures for carbons for filament lamps were £513,500 and £200. The imports of German and Austrian carbons for electric lighting amounted to £24,360, whilst the British imports were a negligible quantity, namely, £201. The German and Austrian imports of dynamos, electric motors, transformers, &c., amounted to £233,400, whilst we imported goods to the value of only £59,900.

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

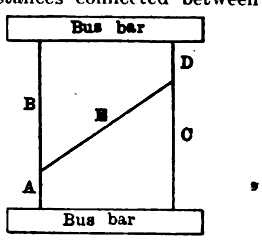
Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

QUESTION No. 1,515.

What is the simplest way of calculating the equivalent resistance of a set of resistances connected between bus bars as per

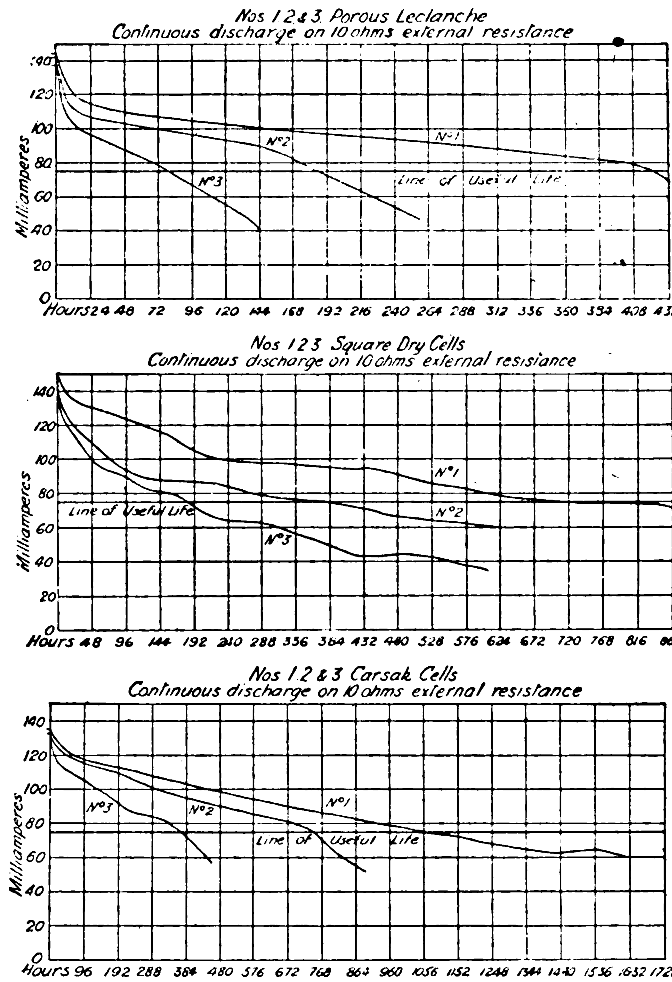


diagram, and also the currents in the various parts. The letters represent the resistance of each part of the network.

G. E. C. PRIMARY CELLS

THE Primary Cell is an article which most people, including many in the electrical industry itself, take very much for granted. Being regarded as so elementary in character and so long standardised, it does not receive so much care in selection as apparatus of a more recent and more complicated character. This is especially the case with the ordinary wet Leclanché Cell. Comparative study will, however, reveal that there are substantial differences in cells which are apparently identical, and that there are several varieties each adapted to a specific purpose. Long experience in the manufacture of these cells in very large quantities leads to a higher standard of uniform results. In the Witton porous pot type of Leclanché Cell, the positive pole consists of a carbon plate surrounded by a mixture of crushed carbon and manganese di-oxide contained in a porous china pot. The greatest care is taken in the selection of the materials, in the proper grading and composition of the mixture, and mechanical means have been designed to ensure the thorough and uniform filling of the pots. All these precautions lead to the production of a porous pot giving the best results obtainable with this type of Leclanché Cell. The cell is made in three standard sizes, the capacity of which ranges from 8 ampere-hours to 40 ampere-hours, and the internal resistance from 0·9 to 0·7 ohms. The E.M.F. in all three sizes is, as with all wet Leclanché Cells, from 1·5 to 1·6 volts. The porous pot Leclanché Cell is usually used with a rod zinc, but a special type has been developed for railway work, which is known as the "Railway pattern," and is particularly suitable for heavy duty, in which the rod zinc is replaced by a circular zinc, thereby lowering the internal resistance.

The most up-to-date development in wet Leclanché Cells is represented by the Witton Carsak Cell, which has been specially developed to meet all conditions of work for which Leclanché Cells are suitable, and more particularly those, such as railway signalling work, where the duty is heavy and more or less continuous. In the Carsak Cell the depolarising mixture of manganese and carbon is in the form of a very tightly compressed block contained in a canvas sleeve. The Carsak Cell is made in 7 sizes, 3 of which correspond exactly to the standard sizes of porous pot. There are two larger sizes for specially heavy work, and two smaller sizes for medical and similar purposes. The capacity of these cells, not counting the two smallest sizes, ranges from 40 to 175 ampere-hours, and the internal resistance is in the neighbourhood of 0·5 to 0·1 ohms, the E.M.F. being as before, 1·5 and to 1·6 volts. The Carsak Cell has from twice to four times the capacity of a porous pot of corresponding size. Weight for weight, the capacity is from two to three times as high. These marked advantages are of special importance for export work when questions of freight are so large a consideration. To obtain the best results from the Carsak Cell a circular zinc should be used, and is



Discharge Curves of G.E.C. Primary Cells.

generally supplied, though there is no fundamental objection to the use of the rod zinc.

In the dry type of Leclanché Cell one of the most important qualities, from the trade point of view, is the absence of deterioration while the cell remains idle in stock. As a result of accumulated experience in manufacture, the General Electric Co., Ltd., is able to guarantee satisfactory results from their cells in this respect. The G.E.C. type of dry cell is made in eight different sizes, each giving 1·50 volts, and ranging in capacity from 5 to 120 ampere hours, with internal resistances varying between 0·10 and 0·30 ohms. The "Century" dry cell is a specially cheap type for general work, but with a somewhat lower capacity than the G.E.C. type. For hot climates and other situations where the conditions are too severe for the ordinary dry cell, the "Extra Sec" Cell is manufactured. Here the electrolyte is in the dry state, and is quite inactive until the cell is filled up with water. Thus this cell will keep in stock for an indefinite period. Its capacity is slightly lower than that of the G.E.C. dry cell, the highest being 24 ampere-hours, with an internal resistance of 0·15 ohms and an E.M.F. of 1·55 volts. The curves reproduced show the performance of the different types of cell on continuous discharge through a circuit of 10 ohms external resistance.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published November 2nd, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

14,209/15. **Incandescent Lamps.** British Thomson-Houston Co. (*G.E. Co., U.S.A.*) A glass-blowing machine comprising a set of rotatable vertical glass tube holders mounted on extending arms of an intermittently rotating frame and co-ordinated mechanism whereby in rest positions of the frame the end of the tube is successively closed, blown, and severed from the remainder, the several operations being automatically and simultaneously performed each upon one of the glass tube ends.

17,366/15. **Heating and Cooking Apparatus.** J. Sayers. Hot-plates with the top composed of an easily fusible metal retained by a circular lip, and forming, when melted, good thermal contact with vessels of turned iron, copper, &c., to be heated.

2,704/16 (*100,387*). **Metal Filament Lamps.** Deutsche Gasgluhlicht A.G. A process for the elimination of moisture residues consisting in introducing metal compounds such as barium azide (BaN_6), which, during the heating of the lamp in course of manufacture, are completely transformed into drying media without giving off gases.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Dynamos, Motors, and Transformers: La Cour [A.C. and D.C. transformers] 103/15; Heys (*Neuland Patents, Ltd.*) [Dynamos] 14,633/15 and 16,643/15; Electromotors, Ltd., Longbottom & Greenhalgh [Dynamos] 16,640/15.

Electrometallurgy: United States Metals Refining Co. [Electrolytic refining] 5,750/16 (*100,318*).

Ignition: British Thomson-Houston Co. & Ralph [Magnetos] 14,851/15.

Instruments: Sullivan [Galvanometers] 14,553/15.

Switchgear: British Thomson-Houston Co. (*G.E. Co., U.S.A.*) [Protective devices] 14,482/15 and 15,633/15; A. G. Brown, Boveri et Cie [Time element circuit-breakers] 14,498/15.

Telegraphy and Telephony: Marks (*Siemens & Halske*) [Supervising telephone connections] 16,340/15; Long [Wireless circuits] 14,729/15; Simonsen [Telegraph insulators] 15,142/15; Slatter and St. John [Telephone accessories] 17,160/15; A. F. Dixon [Multiplex printing telegraphy] 4,806/16 (*100,306*).

Traction: Vacuum Brake Co., H. J. Dover, and W. P. Walker [Current collectors] 1,116/16 (*101,737*).

Miscellaneous: Harry W. Cox & Co. and Teu Bruggenkate [Interrupters for inductive circuits] 14,503/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Heating: J. Hanssen [Food steriliser] 14,524/16 (*101,804*).

Ignition: C. Messerschmidt [Magneto timer] 6,378/16 (*101,783*).

Switchgear: British Westinghouse Elect. & Mfg. Co. [Circuit interrupters] 14,276/16 (*101,796*).

Telegraphy and Telephony: Western Electric Co. [Duplex circuits] 14,546/16 (*101,805*).

Miscellaneous: G. Giles [Condensers] 14,416/16 (*101,801*).

Opposition to Grant of Patents

Opposition has been entered to a grant on the following application:—

17,008/15. **Engine Starter.** B. Brooks and W. Holt. An electric engine starter for automobiles, in which the motor pinion is mounted on a sleeve sliding laterally on the armature shaft, and is drawn into mesh at the commencement of rotation by a screw thread cut in the sleeve.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

25,023/02. **Printing-press Drive.** G. H. E. Kohler. A system of driving printing presses and like machinery, where a slow speed with the possibility of frequent and accurate starting and stopping is required, as well as a higher working range of speeds. Two motors are provided. The smaller one driving through worm or other gearing is used for the slow speeds, and the large direct-coupled motor takes up the drive at the higher speeds overrunning the small motor, to which it is connected by a free-wheel clutch. The control gear is actuated by push-buttons and electrically interlocked.

The following are the more important Patents that have become void through non-payment of renewal fees.

Electrometallurgy and Electrochemistry: Gröndal Kjellin Co. and J. Härdén [Electric furnaces] 16,296/06.

Switchgear, &c.: British Thomson-Houston Co. (*G.E. Co., U.S.A.*) [Motor control] 16,195/06 and 12,684/08.

THE INSTITUTION LOCAL SECTIONS

We give some further information with regard to the Local Sections of the Institution of Electrical Engineers. Reference has already been made to the Western Local Section (Electrical Engineering, October 26th, p. 410).

The Manchester Section begins its meetings on Tuesday next, November 14th, at the Engineers' Club, Albert Square, at 7.30 p.m., when the chairman, Mr. A. E. McKenzie, will deliver his address. Up to the end of January meetings have been arranged as follows:—November 28th.—J. S. Peck, "The Parallel Operation of Electric Power Stations." December 12th.—A. P. M. Fleming, illustrated lecture, "Some Aspects of Industrial Research, with special reference to American Research Activities." January 16th.—F. Gill and W. W. Cook, "The Principles involved in Computing the Depreciation of Plant." January 30th.—J. Drummond Paton and Julius Frith, "Fuel Economy." The dates for the remainder of the session are February 13th and 26th, March 13th and 21st, and April 3rd.

Dr. Alexander Russell will open the session of the Birmingham Local Section on Wednesday next, November 15th, at the University at 7 p.m. with the Kelvin Lecture, which is being delivered in London to-night. So far arrangements have only been made for two further meetings—namely, December 6th, when Mr. J. S. Peck will read his paper on "The Parallel Operation of Electric Power Stations," and January 17th, when the paper by Messrs. Gill and Cook will be read.

Monthly meetings as usual will be held by the Scottish Local Section, the first being on Tuesday next, November 14th, when the chairman, Mr. J. K. Stothert, will deliver his inaugural address, at 207 Bath Street, Glasgow. At the meeting on December 12th, also in Glasgow, Mr. Peck's paper mentioned above will be read; on January 9th there will be a meeting at Princes Street Station Hotel, Edinburgh; on February 16th, in Glasgow, Dr. Alexander Russell will give the Kelvin Lecture, and the two subsequent meetings are on March 13th and April 3rd.

OBITUARY

The many friends of Mr. A. H. Howard, late secretary of the Cable Makers' Association, will regret to hear of his death, which took place on November 1.

Mr. A. H. Howard was born at Providence, Rhode Island, U.S.A., in the year 1862, and was educated at Brown's University, Providence, R.I. He came to England in the year 1881, and was associated with Mr. Henry Edmunds and the late Mr. Glover, of the firm of Messrs. W. T. Glover and Company, in the early cable-making days. After the death of the late Mr. Glover, and the conversion of this business into a limited company, Mr. Howard became one of the first directors. It was during this period that the Cable Makers' Association was founded, and he became its first secretary. After Mr. Howard left the Board of W. T. Glover and Co. and entered into practice as a Consulting Engineer, he remained the secretary of the Association, and for some years past devoted all his time and attention to the growing work of this Association. Mr. Howard has been in poor health for some little time, but it was only so recently as the end of September that he felt it necessary to resign his work with the Association, with which he has been so long and successfully connected.

ELECTRIC VEHICLES

Need for a British Industry

WE reproduce below the main portions of two circular letters which the Electric Vehicle Committee is distributing, the object being to impress upon electrical and automobile engineers respectively the necessity for concentrating greater attention upon the manufacture of electric vehicles in this country than has hitherto been the case.

The first letter, which has been sent to electrical manufacturers, reads as follows :—

The Electric Vehicle Committee desire to draw your attention to the increasing use that is being made of the electric battery vehicle in this country. Most of the vehicles that are being put into service are of American manufacture, but there is no reason whatever why they should not be produced in this country. The only firm now building them in England has shown that it is possible to turn out a vehicle that is quite as good as any machine that has hailed from the other side of the Atlantic.

The Committee do not doubt that after the war, if not before then, more than one British manufacturer of petrol vehicles will turn his attention to the production of the electrical type as a branch line of business. The Committee consequently feel that the time is opportune for electrical manufacturers to turn their attention to the preparation of designs for standard lines of motors and controllers for use upon electric vehicles.

Should you contemplate doing anything in this matter, we should be very pleased to assist you with any information that we are able to supply.

In a much longer communication the Committee urge automobile manufacturers to take up the electric vehicle as a parallel operation.

The Electric Vehicle Committee desire to draw your attention to the increasing use that is being made in this country of the electric battery vehicle, and to suggest that the time is opportune for the automobile manufacturers to turn their thoughts towards making arrangements for the building of electric vehicles, after the war, as a branch line to their petrol vehicle business. In support of this suggestion, the Committee put forward the following considerations :—

1. The success that has followed the adoption of electric vehicles for commercial purposes by well-known firms, such as Messrs. Harrods, Ltd., Messrs. Lyons & Co., Hays Wharf Cartage Co., Vickers, Ltd., and many others, by railway companies, as, for instance, the Midland Railway Co., with a fleet now nearing 100 in number, clearly establishes the fact that there is a place for this type of vehicle for the haulage and delivery of goods in cities and towns and their suburbs. Actual operating costs demonstrate its superior economy and adumbrate its universal employment for such work in the future. It will undoubtedly come to be recognised that there are distinct and definite spheres of utility and suitability for the different haulage systems, viz. : (*a*) long-distance work for petrol and steam vehicles, and (*b*) urban and inter-urban work for the "electric."

2. While paragraph 1 deals exclusively with commercial vehicles, it is not less certain that early recognition will be given to the advantages of the electric passenger-carrying vehicle, public or private, for all "about-town" and suburban services where the limit of its mileage capacity per charge fits in with the day's requirement. Since the modern electric passenger car, as now built in the United States, will give an every day average mileage per charge, over give and take roads, of from 70 to 80 miles, the electric battery system can easily take care of the requirements of all such work as outlined above. The excellent and economical results that have attended the employment of electric battery 'buses, of the modern type, at South Shields, York, and other places promise an extension of their employment as public service vehicles.

3. While the requirements connected with the war, and the difficulties with shipping, largely account for the present high price of petrol, it is evident that the extraordinary growth in the use of petrol motor vehicles in the United States is causing such an increase in the demand for petrol in that country alone that, in the future, there is bound to be a considerable decrease in the quantities available for export to this country. It is quite possible, therefore, that unless some steps are taken to ease the demand there will be a positive shortage of motor spirit in the near future. A great deal can be done to ease the demand for motor spirit by the adoption of the electric vehicle for the services outlined in paragraphs 1 and 2 above. The general employment of such vehicles for town work would free a very considerable quantity of petrol, and, for this reason alone, the Committee submit that it is in the interests of the petrol car manufacturers to encourage the use of the "electric" and to take up its manufacture.

4. The majority of the electric vehicles at present in use in this country are of American manufacture. There is no reason why such vehicles should not be produced in our own country. The one British firm engaged in building the commercial type of electric vehicle has shown that it can turn out quite as good a machine as anything that has hailed from America.

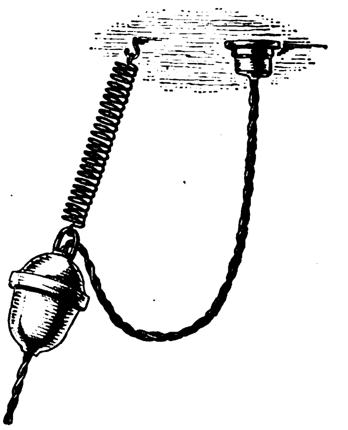
5. A firm manufacturing petrol vehicles would find no difficulty in taking up the manufacture of the "electric" as a parallel operation. Apart from the engine and gear-box, radiator, petrol tank, &c., there is little difference in chassis construction as between the petrol car and the electric car. As to electric motors and the controlling switchgear, these will be obtainable from the electrical manufacturers, while batteries guaranteed to give reliable service can now be obtained from the leading accumulator makers. It cannot be too often emphasised that the batteries that are now produced by the leading firms are thoroughly reliable and satisfactory in vehicle service, and in details of construction bear little resemblance to the batteries that were the main cause of the failure of the British electric vehicles in the nineties.

Should you contemplate doing anything in this matter, we should be glad to assist you with any information that we are able to supply.

It may be mentioned that the Committee is constantly being asked for names of British manufacturers of electric vehicles, and just recently have had a request from the Commercial Motor Users' Association for a list for insertion in the new edition of their Handbook. So far the Committee have only been able to quote the name of one British manufacturer, the firm of Ransomes, Sims & Jefferies, of Ipswich, as makers of the heavy type of electric vehicle in this country. The Committee trust they may soon be in the position to add other names to the list.

THE "NEVA-KNOT" ADAPTOR

FROM a note referring to this useful device introduced by Engineering Arc Lamps, Ltd. (St. Albans), which appeared in our columns recently, it might be inferred that the apparatus is of the nature of a cord absorber. This, however, is not the case. The real function of the device is to form a frictionless contact device or coupling, whilst the spring, which is a secondary part of the apparatus, does act as a cord absorber over a limited range, which is sufficient for most purposes. The object of this spring is to keep the flexible taut and the function of the frictionless adaptor or coupling is to allow this flexible, attached to the laundry iron or electrical tool, to rotate perfectly freely, however much it is twisted about, thus preventing any knotting or kinking.



Where the movement necessary is small the adaptor can be used without any spring or cord absorber at all, and where considerable motion is essential a real cord absorber can replace the spring and the upper flexible.

The action will be better understood by reference to the accompanying illustration.

INSULATING VARNISHES

A VERY important item in the construction of electrical machinery and one on which success or failure of the insulation often depends is the quality of the varnish and other similar preparations employed. A firm that has made special efforts in specialising in this direction is Jenson and Nicholson, Ltd. (Stratford, E.), and we have before us a pamphlet giving particulars of their British standard insulating compositions, which cover a wide range of the requirements of the electrical trade. A very durable material for armature and field coils, controllers and switchgear and especially for railway and tramway equipment, is the black "Lacwatt," made in three varieties, for prolonged baking, air-drying and quick air-drying. A golden-coloured variety is also made. All these are particularly moisture and grease-proof, non-corrosive and plastic. A finishing composition known as "Coilac," is another speciality and other special products include mica sticking varnishes, core plate varnish, acid-proof enamel, and a series of "Mafinal" machine-finishing enamels, which should be found of great use and convenience. The information given in the pamphlet regarding the necessary adjustments of specific gravity of varnishes according to temperature shows the care with which the subject has been studied, and we understand that the firm's representatives are always willing to put the results of their extensive experience in these matters at the disposal of customers.

WESTINGHOUSE SUPPLIES

RECENT lists from the Supply Department of the British Westinghouse Electric and Manufacturing Co., Ltd. (Long Millgate, Manchester), deal with electric cooking and heating novelties, domestic motors and vacuum cleaners. A particularly neat chafing dish set used in conjunction with a standard 6-inch disc stone or hot-plate is shown in Fig. 1, the hot-plate being attached to the chafing-dish stand when

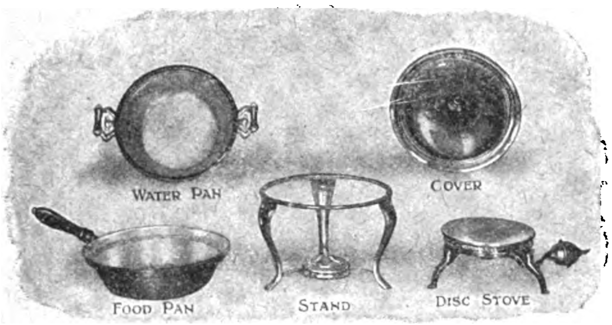


FIG. 1.—6-INCH DISC STOVE AND CHAFING DISH.

required by the simple expedient of reversing its supporting feet and using them to suspend the disc in the ring of the stand. Other heating appliances include domestic irons, toasters of various forms, some simple but artistic designs of lamp type radiators as well as convectors. Another interesting domestic appliance in the same leaflet is the Westinghouse "utility" motor, which is provided with various accessories and can be used for driving sewing machines, polishing silver and metal ware, pans, etc., sharpening knives, ventilation, as

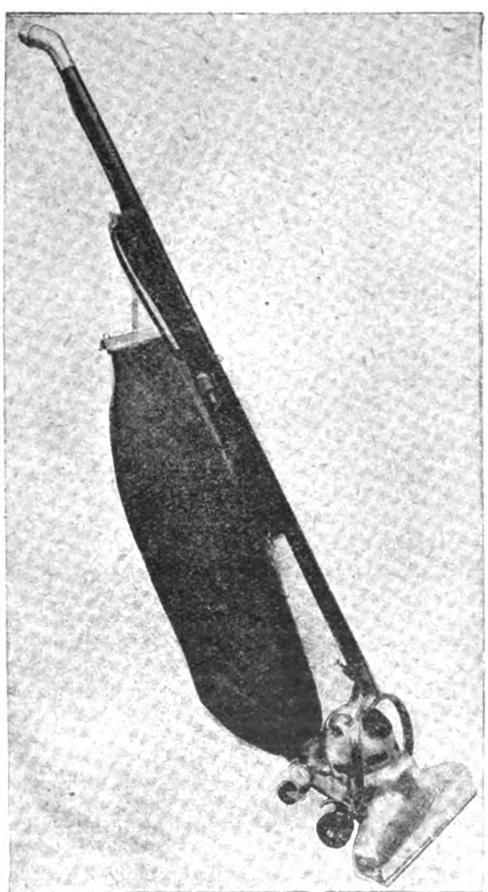


FIG. 2.—PREMIER VACUUM CLEANER.

well as for such non-domestic purposes as running jewellers' or dentists' lathes. The polishing heads, etc., are of course attached direct to the spindle of the motor, and the sewing machine drive is by a belt put in and out of action by a jockey pulley.

The types of vacuum cleaner listed include the self-contained "Premier" outfit, of which the working parts are shown in Fig. 2, as well as some larger patterns of machine. The extreme simplicity of the mechanism of the Premier is apparent from the figure, which shows the little motor and the direct driven high-speed exhaust fan removed from the casing.

SEARCHLIGHTS

A LIST from Crompton and Co., Ltd. (Chelmsford), gives interesting information on the standard forms of searchlight projector, for commercial as well as naval and military purposes. These designs embody many years of experience, and include a variety of different types, ranging in size from 12 to 60 in. diameter, and embracing hand-controlled as well as electrically-trained and elevated lights of fixed and portable patterns. There are naturally many particulars that cannot be published at the present time of the apparatus supplied to the Services, but the numerous illustrations in the list give an excellent idea of some of the refinements of modern appliances of this kind. The lamp usually employed uses horizontal carbons in gunmetal holders with suitable adjustments for centering. The striking mechanism comprises a series magnet, arranged to pull the carbon-holders apart, and the automatic feed gear includes a shunt magnet arranged to control a vibrating armature, fitted with a make and break attachment. A pawl attached to the armature actuates a ratchet wheel fixed to a right- and left-handed screw controlling the carbon-holders.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"Joseph Pennell's Pictures of the Wonder of Work." 10¼ in. by 7½ in. 52 plates. (London: William Heinemann.) 7s. 6d. net; abroad 8s. 6d.

[A series of drawings, etchings and lithographs of various industrial and other works in different parts of the world.]

"Telegraphy." By T. E. Herbert. 985 pp. 7½ in. by 5 in. 630 figures. (London: Whittaker & Co.) Third edition. 9s. net; abroad 9s. 9d.

[A new edition giving a detailed description of the telegraph system of the British Post Office.]

"Eclipse or Empire." By H. B. Gray and S. Turner. 316 pp. 7¼ in. by 4¾ in. (London: Nisbet & Co., Ltd.) 2s. net; by post 2s. 3d.

[An attempt to show how Great Britain to-day is not, as she was forty years ago, the workshop of the world.]

The Electrical Industry and Excess Profits.—A number of other applications on behalf of the electrical industry have been made to the Commissioners of Inland Revenue for an increase in the statutory percentage of profit allowed by the Finance Acts for the purposes of assessment for excess profits. We referred to a previous application on page 419 of our last issue, and are now able to state that the electric supply companies of London, as we indicated a short time ago, have asked for special consideration on account of the limitations and restrictions under which they are working, and also on account of the fact that in the early days of those undertakings it was impossible to earn an adequate return upon the capital expenditure involved. Mr. H. B. Renwick, managing director of the County of London Electric Supply Co., has taken a leading part in this movement and is representing certain of the London companies, whilst Mr. W. F. Fladgate, Chairman of the Charing Cross, West End and City Electricity Supply Co., is representing other London undertakings. The facts have already been placed before the Board of Referees, and the result is now awaited.

Decisions have been given raising the statutory percentage from 6 per cent. to 7½ per cent. in the case of tramway undertakings in the United Kingdom owned by companies, and to 8 per cent. in the case of tramway undertakings owned by private individuals. This application was made by the Tramways and Light Railways Association. In respect of the electric supply undertakings in Victoria (Australia), the percentage has similarly been increased to 7½ per cent. and 8 per cent. respectively. In this instance the application was made by the Melbourne Electric Supply Co., and another. The same increase applies to the tramways there. In respect of the electricity supply and traction undertakings in India, the increased percentages are 7 per cent. and 8 per cent. respectively.

LOCAL NOTES

Accrington: *Electricity Employees' Wages.*—The workmen employed by the Electricity Committee have been granted an increase of wages amounting on the average to 20 per cent. on pre-war rates.

Belfast: *Suggested New Station.*—A deputation of the electrical trades of the city waited upon the Corporation last week and suggested that a new station with an initial capacity of at least 5,000 kw. should be put in hand immediately. It was pointed out that there is at present a great demand for current both for power and lighting, which the Corporation is unable to meet, with the result that the legitimate business of the electrical contractors of the city is being considerably curtailed. It was further pointed out that the margin in the existing power house is only 11 per cent., whereas in other parts of the United Kingdom the large electric supply undertakings have a margin varying from 20 to 50 per cent. The Lord Mayor, who received the deputation, pointed out, as of course was well known, that this matter has been receiving considerable attention for some time past and that the Corporation has been divided in opinion upon it. He promised, however, that the views of the deputation would be given consideration.

Engineer's Report on Electricity Undertaking.—At the last meeting of the Corporation, Mr. T. W. Bloxam, the City Electrical Engineer, reported that he anticipated a shortage of electrical energy during November and December, and a more pronounced shortage next year. He therefore urged the Committee to re-open the question of installing new plant either by extending the present power house or by building a new one. The Chairman of the Tramways and Electricity Committee, who placed this report before the Corporation, referred to it as an important one and mentioned at the same time that the public had been notified that it did not follow that all applications for additional current or for new supplies could be granted.

Birmingham: *Supply Interruptions.*—There have been further interruptions in the supply of electrical energy, and as on previous occasions the Tramways Department has been the chief sufferer. The output of the Department has increased from 80 million to 150 million units during the last two years and, as we have mentioned before, the troubles at present being encountered are due solely to the difficulty of obtaining the delivery of new plant. One new set had been promised for the end of September, but it has not yet been delivered and is now promised for the middle of December. The chief reason assigned for the most recent interruption is the inferior quality of some of the coal which the Department now has to burn.

Clyde Valley: *New Power Company's Station.*—The Clyde Valley Electrical Power Co. has just put into operation a new 5,000 kw. turbo-alternator power house at Cambuslang. The turbine is of the Rateau type, and the set, which generates three-phase current at 25 cycles, is similar to the five machines at the Company's existing Yoker and Motherwell power stations. The boiler plant is by Messrs. Babcock and Wilcox. The present capacity of the new power house is merely a beginning, and the design contemplates one of the largest power stations in the United Kingdom.

Dublin: *Proposal to Appoint Electricity Manager.*—A number of reports have been presented to the Special Committee appointed a short time ago to inquire into the administration of the electricity undertaking. Mr. P. W. D'Alton, the outside expert consulted, whilst paying a tribute to the administration and control of the undertaking, considers that a mistake has been made in the choice of the site of the power house, and at the same time disagrees with the present policy of having the engineering and executive sides of the undertaking in separate hands. He advocates that the engineer should also be the manager and responsible for the successful conduct of the undertaking, both commercial and engineering. A report has also been presented by Mr. Mark Ruddle, the City Electrical Engineer, and the Special Committee, in bringing the matter before the Corporation, suggested that Mr. D'Alton should be asked upon what terms and conditions he would undertake the entire management of the electricity undertaking during a period of three years. The charges for electricity are regarded as unduly high for private supply, but not unreasonable for public lighting. At the same time it is suggested that reductions in the number of workmen employed at the Pigeon House power station are possible, and would follow upon the greater use of modern machinery and selection by the power house superintendent. In other departments Mr. D'Alton also considers the salaries and wages are too high, and that the coal supply also wants overhauling. Another matter touched upon is the poor load factor, which prejudices the economic prospects of the undertaking and the opinion is affirmed that proper canvassing by trained and expert persons, consideration to large potential consumers for long hours of power and light, and more favourable rates to such consumers, would bring about the desired improvement.

York: *Linking-up.*—As a result of the appeal by the National Electric Power Joint Committee for the formation of District Committees to consider questions relating to linking-up by electricity undertakings throughout the country, the City Electrical Engineer has been instructed to report to his Committee on the matter.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Aberdeen.—A sub-station is recommended at York Place, at an estimated cost of £2,800.

Dewsbury.—The Local Government Board has been enquiring of municipal authorities the probable directions in which they will wish to undertake new works after the war, and in accordance with instructions the Borough Electrical Engineer has gone into the matter as regards the Electricity Department. He has prepared an estimate, based on pre-war prices, amounting to £35,800 for extensions at the electricity works, made up as follows:—Two 2,000 k.w. turbo-alternators and condensers, £14,000; two 500 k.w. rotary converters, £4,000; two 250 k.w. rotary converters, £1,250; switchboard, £1,600; cables, £8,400. It is also estimated that when the load exceeds 2,000 k.w. an extra boiler will be required, which, together with an additional cooling tower and coal conveyors, is estimated to cost £6,500.

New Zealand.—A loan of £16,000 is to be applied for at Stretford (North Island) for electric power supply purposes.

Sheffield.—Additional plant is required at the Neepsend power station, and the Electric Supply Committee recommend that Sir Alexander Kennedy be called in to advise.

Stafford.—New mains are to be laid at an estimated cost of £1,000.

Miscellaneous

Liverpool.—The Cheshire Lines Committee require a supply of telegraph materials and carbons. Secretary, Central Station, Liverpool, November 22.

Rotherham.—The Tramways Department require six double-deck top-covered cars. Town Clerk, November 16.

South Africa.—The Johannesburg Council require 250 field coils for tramway motors, and automatic pressure regulators for the A.C. turbo-generators at the Council power station. Copies of the specification may be seen at 73, Basinghall Street, E.C.

The Durban Corporation requires a 3,000 kw. steam turbo-alternator and condensing plant. Tenders by January 3, but the specification may be seen as above.

APPOINTMENTS AND PERSONAL NOTES

At a meeting of the Metropolitan Association of Tramway Managers recently, Mr. W. C. Ullmann (East Ham) was re-elected vice-chairman, Mr. W. E. Hammond was elected vice-chairman, and Mr. T. B. Goodyer was re-elected hon. secretary.

Dr. H. E. Armstrong, F.R.S., has been elected a manager of the Royal Institution in place of the late Professor S. P. Thompson.

A Switchboard Attendant is required at Fulham (see an advertisement on another page).

The Canterbury Corporation Electricity Department requires a Junior Shift Engineer (see an advertisement on another page).

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £143 to £146 (last week, £141 to £144).

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Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
"Lamlok," 18, Ranelagh Gdns., Hammersmith, W.
London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
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Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

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Gmur & Co., Ltd., Aarau, Switzerland.

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Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

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Waygood-Otis, Ltd., Falmouth Rd., S.E.

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Underfeed Stoker Co., Ltd., Coventry House, South Place, E.C.

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British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

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Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

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Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
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Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

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WIRING CONTRACTORS. See page iv.

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SUMMARY

THE annual Kelvin lecture on some aspects of the life and work of Lord Kelvin was given by Dr. Alexander Russell last Thursday at the Institution of Electrical Engineers (p. 432).

IN a Paper read last week before the Institution of Automobile Engineers, Mr. A. L. Clayden dealt with some features of American car-lighting and engine-starting systems (p. 433).

THE arrangement of a battery booster installation is gone into at some length in our "Questions and Answers" columns (p. 434).

THE Belfast Electricity Committee have recommended that they be authorised to report upon a complete scheme of extensions with a view to meeting the constantly increasing demands (p. 435).

AMONG the subjects of specifications published at the Patent Office on Thursday last were surge arresters, circuit-breakers, and wireless telegraphy. Patents relating to instruments and wireless telegraphy expire this week after a full life of fourteen years (p. 436).

THE Hampstead magistrates have decided that a bath-chair driven by a ¼-h.p. electric motor is a motor-car (p. 436).

A REVIEW of a publication dealing with rotary converters appears on p. 437.

THERE was a deficit of £2,087 at Ipswich last year.—The arrangements with regard to street lighting at Manchester are criticised (p. 438).

NEW plant is required at Finchley, Sunderland, and York (p. 438).

A SATISFACTORY year is reported by the Edison & Swan Co. for 1915-16 (p. 438).

Arrangements for the Week.—(*To-day*) *Thursday, Nov. 16th.*—Greenock Electrical Society, 22 West Stewart Street. "A Criticism of the I.E.E. Rules," by H. Piggott, 7.45 p.m.

Friday, Nov. 17th.—Batti-Wallah Society. Dinner at Victoria Mansions Restaurant, Victoria Street, London, S.W., 6.30 p.m.

Saturday, Nov. 18th.—Association of Mining Electrical Engineers, Notts. and Derbyshire Branch. University College, Nottingham. "Some Electrical Troubles and their Remedies," by T. Anderson, 3.30 p.m.

Birmingham and District Electric Club. Swan Hotel, New Street. "Notes on the Export Trade to the Far East," by W. G. L. Riddle, 7 p.m.

Monday, Nov. 20th.—Electro-Harmonic Society. Holborn Restaurant. Concert (Ladies' Night), 6.15 p.m.

Thursday, Nov. 23rd.—Institution of Electrical Engineers. "The Parallel Operation of Electric Power Stations," by J. S. Peck, 8 p.m.

NATIONAL ELECTRICITY POWER SUPPLY

A Scottish Committee

ARRANGEMENTS have been made to form a Scottish Committee in conjunction with the National Electric Power Supply scheme, to deal with the undertakings in the West Coast of Scotland area shown on the map given on p. 384 of our issue for October 12.

A meeting was held at the Technical College, George Street, Glasgow, on Friday, November 3rd. Mr. J. K. Stothert was in the chair, and Mr. F. H. Whysall acted as secretary.

The following were present:—R. Allan Brown, Falkirk; G. F. Moller, Lanarkshire Tramways; Glynn Salter, Hamilton; Archd. Page, Glasgow; W. W. Lackie, Glasgow; James Wishart, Motherwell; H. E. Ferguson, Clyde Valley Electric Power Co.; C. F. Parkinson, Paisley; Fred Coutts, Paisley Tramways; W. C. Bexon, Kilmarnock; Ian C. A. Murray, Balfour, Beatty and Co., Edinburgh; H. Dixon, Dumbarton; E. C. Churchward, Scottish Central Electric Power Co.; Roland Marshall, Ayr; F. H. Whysall, Greenock.

Invitations were also sent to the Resident Engineer, Cambuslang; S. Williams, Wishaw; James Dalrymple, Glasgow Tramways; J. White, Kilmalcolm; D. A. Starr, Clyde Valley Electric Power Co.; A. Scott Moncrieff, Dumbarton; C. P. Sparks, Airdrie and Coatbridge Co.

The Chairman explained to the meeting his position in the matter, after which he called on the Acting Secretary to read the Board of Trade circular, dated May 25th, 1916, on Inter-Connection of Electric Supply Undertakings.

Mr. W. W. Lackie, as a member of the National Electric Power Supply Joint Committee, explained their attitude and the objects of the movement, and after some discussion it was decided that all those present or invited to the meeting should constitute the Committee. Mr. Stothert then explained that he did not desire to act as Chairman of the Committee to be formed, and Mr. George Balfour, of the Scottish Central Electric Power Company, and Messrs. Balfour, Beatty and Co., Ltd., was appointed Chairman of the West of Scotland Linking-up Committee. Mr. F. H. Whysall was appointed Vice-Chairman and Hon. Secretary.

A sub-committee was appointed to start work, and the following were appointed:—Messrs. Brown, Bexon, Churchward, Lackie, Parkinson, Starr and Wishart.

The Secretary was instructed to write to the various authorities in the area for particulars necessary for the consideration of the sub-committee and the drawing-up of the necessary map showing the way in which the area is at present served.

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE, S.W.
ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Platoon Commander A. Gerard.

Next for Duty.—Platoon Commander W. J. Watkins.

Monday, Nov. 20th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25 to 8. Lecture on Telephones, 7.30.

Tuesday, Nov. 21st.—School of Arms, 6 to 7. Lecture, 7.15, "Squad and Platoon Drill," Coy.-Cdr. Fleming.

Wednesday, Nov. 22nd.—Instructional Class, 6.15. Platoon Drill, Platoon No. 2.

Thursday, Nov. 23rd.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.

Friday, Nov. 24th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25 to 8.25. Lecture on Telephones, 7.30.

Saturday, Nov. 25th.—Parade, 2.20. Uniform. For Inspection by the County Commandant at 3. As a full muster is important, every member should attend.

Sunday, Nov. 26th.—Entrenching at Otford. Parade Victoria (S.E. & C. Ry. Booking Office), 8.45 a.m. Uniform, haversacks, water-bottles. Midday ration to be carried. Railway vouchers will be provided.

Musketry.—For all Companies. See Notice and Tables A and B at Headquarters.

Unless otherwise indicated, all drill, &c., will take place at Headquarters.

War Materials.—The Ministry of Munitions is desirous of extending the output of casting and stamping fuze bodies and sockets, and casting and rolling brass rods for the components. Firms possessing suitable machinery and capable of undertaking such work are requested to communicate at once with The Central Clearing House for Engineering Resources, Ministry of Munitions, 8-9, Northumberland Street, Northumberland Avenue, W.C.

THE KELVIN LECTURE

THE eighth Kelvin lecture on "Some Aspects of Lord Kelvin's Life and Work" was given by Dr. Alexander Russell, at a meeting of the Institution of Electrical Engineers on Thursday last. Dr. Russell commenced with some notes on the great man's early training at Glasgow, showing how the foundations of his mathematical knowledge were derived from his father, James Thomson (Professor of Mathematics at Glasgow University), whose classes he attended at the early age of eight. Before leaving Glasgow for Cambridge he had already written mathematical papers on mathematical theories of heat and electricity. The lecturer traced at length some of his earlier progress of thought in electrical theory, including his conception of capacity and the method of "electric images," by which he solved various problems on the mutual attractions and repulsions of charged bodies. Continuing, Dr. Russell referred to Thomson's remarkable paper, published in 1851, on "Applications of the Principle of Mechanical Effect to the Measurement of Electromotive Forces and of Galvanic Resistance in Absolute Units," which start laid the foundations of the whole subject of practical electrical measurement. Thomson, in these days, pointed out the lecturer, was a sever critic of Weber's theory that an electric current consists of the motion of particles of two kinds of electricity moving in opposite directions. Weber assumes that the forces exerted by these particles on other particles of electricity when in relative motion are different from those they would exert when at relative rest. Thomson points out that Weber's assumptions are quite unwarrantable. As his conclusions also are inconsistent with the Conservation of Energy they must be wrong. In the light of later developments in wireless telegraphy it is interesting to note that as far back as 1853 Thomson read a paper on the "Oscillatory Discharge of a Leyden Jar" to the Glasgow Philosophical Society.

The great practical importance of this paper lies in the fact that it led many physicists to study the problems of oscillatory discharge most carefully, and wireless telegraphy was the direct although unexpected outcome of their labours. It has to be remembered, however, that Thomson's theory is not complete. Of the energy originally stored in the jar we now know that some is radiated into space. In many cases this amount is negligibly small and Thomson's theory is directly applicable. In a paper on the "peristaltic" induction of electric currents, in 1856 Thomson discussed capacity effects between neighbouring wires, cable sheathings, etc., and developed, equations applicable with but slight extension to polyphase power transmission problems.

Regarding his work in connection with the early Atlantic cables, Dr. Russell continued as follows :—

The first attempt to lay a cable across the Atlantic was made in 1857. It broke in 2,000 fathoms of water 330 miles west of Valentia. In 1858 it was decided that the U.S. frigate *Niagara* and H.M.S. *Agamemnon* should steam in opposite directions each with half the cable on board and splice it in mid-ocean. Professor Thomson was engineer in charge of the electrical testing on board the *Agamemnon*. After many mishaps the cable was safely laid on August 6th, 1858, and some messages were sent. On September 6th of this year messages ceased to pass, and Thomson and the other engineers were appointed to report on the cause of the breakdown. In experimenting with the cable from the Valentia end, Thomson found that it acted in the same way as if it were an insulated copper conductor 270 miles long with its end connected with a copper plate sunk at this distance in the Atlantic. He took the opportunity of investigating the earth currents in it. He proved that electromagnetic induction due to the diurnal variations of terrestrial magnetism was a prominent cause, but he failed to trace the other disturbing cause or causes. A day seldom passed without the direction of the earth current changing several times. So far as he was able to see, however, there was no connection between the times of reversal of current and the solar hours. In 1865 and 1866 Thomson acted as electrical engineer during the laying of the second and third Atlantic cables. He also acted as consulting engineer for various cable companies. The troubles experienced with the 1858 cable led Thomson to invent the mirror galvanometer. The "ironclad" mirror galvanometer used with this cable is kept with other historical apparatus in the laboratory at Glasgow University. This was replaced by the spark recorder and finally by the siphon recorder.

Another important paper of Thomson's in 1860 was on the "measurement of the electric motive force required to produce a spark in air between parallel metal plates at different distances." This furnished a starting point given which the present method of calculating corona losses have been developed. Other activities of the great man, touched on by the lecturer, perhaps a little less nearly connected with electrical engineering, were the theory of nortices, the diffusion of heat, and the effect of clothing a body on its temperature. In the last-mentioned he showed that if a body be below a certain size the effect of clothing may be to cool it. In this connection Dr. Russell suggests that insulating overhead transmission wires with a suitable material might not only prevent the losses due to the formation of a corona but might allow more power to be transmitted without overheating the wires.

Thomson's earlier views of the age of the earth and the sun are well known, but are much reflected by later discoveries of radio-activity.

In his later years, continued the lecturer, Kelvin was strongly attracted by the mystery of radium. Curie's astounding discovery that it emitted heat at the rate of about 90 calories per gramme per hour seemed to him explainable only on the theory that the energy of the radium was supplied by ethereal waves from outside. He gave as an illustration the case of a piece of cloth hermetically sealed in a glass vessel surrounded by water and exposed to the sun's rays. We know that the water will be perceptibly hotter when the cloth is black than when it is white. The energy travels into the black cloth by rays of sunlight and outwards through the same space by thermal conduction. The idea that the energy could arise by a change in the atom seemed to him incredible.

Regarding Lord Kelvin's connection with the Institution of Electrical Engineers, and of the practical side of electrical engineering, Dr. Russell continued as follows :—

About 1870, telegraphists discussed the desirability of founding a society of telegraph engineers, and many of them naturally desired to have Sir William Thomson as the first President. As a matter of fact, the initiative seems to have been taken by Colonel Sir Francis Bolton, General Webber, Sir William Siemens, and Colonel Malcolm of Poltalloch. In 1872 Sir William Siemens was our first President, and it was not until 1874 that Sir William Thomson became President, Lord Lindsay, who was afterwards the Earl of Crawford and Balcarres, being one of the Vice-Presidents.

In 1877, when a juror at the Exhibition of Philadelphia, Thomson wrote a report on the exhibit of Gramme dynamos. He fully appreciated the enormous advance made by the abolition of permanent magnets. In 1878 he advocated the generation of electricity "in bulk." In 1879 he pointed out the suitability of the electric arc for street lighting and estimated its efficiency as 1·8 candles per watt. In 1881 he was most enthusiastic over the Faure accumulator, and his encouragement was a great help to the industry. This year he enunciated Thomson's law and pointed out the load at which the electrical efficiency of a shunt dynamo was a maximum. He also patented a special winding for a shunt dynamo. Ferranti independently invented an improvement of this design. They therefore entered into a working agreement and this association was influential in turning Thomson's attention to several of the problems which were then occupying the minds of engineers. In 1889, when the Society of Telegraph Engineers and Electricians changed its title to the Institution of Electrical Engineers, Thomson was again President. He was our President for the third time in 1907, the year of his death.

The wonderful series of electric measuring instruments which Thomson invented will always bear witness to his genius, his energy, and his inventive skill. Three of his ampere balances have been in use practically continuously at Faraday House for the last 27 years under ordinary commercial conditions. They are as accurate and useful now as when they were bought.

In 1881, Sir William Thomson and J. T. Bottomley communicated to the British Association the results of their tests on glow lamps. They measured the candle-power by a Rumford's photometer and a "standard candle," and the current and pressure by graded galvanometers. In addition they pointed out the necessity of determining the life of the lamp and how the candle-power diminishes with the blackening of the bulb. So far as the author is aware these are the first published tests of lamp efficiencies. The results are given in candles per horse-power. Horse-power was possibly adopted so that the efficiency would be expressed by a whole number, the greater this number the higher the efficiency—or it may have been adopted because the term "watt" was at that time too academic for the general public. The efficiencies of glow lamps are now expressed in "candles per watt," but for years they were always expressed in terms of the inefficiency of the lamp, that is, in "watts per candle." In the photometry of new types of lamp the efficiency must be expressed in mean spherical candles per watt as the total light sent out by the lamp has to be measured. When this is done in testing the new gas-filled series lamps interesting phenomena are noticed. For instance, in certain lamps, when rotated, the candle-power continually increases with the speed of rotation. At 180 revolutions per minute the light may be about 15 per cent. greater than when the lamp is stationary. At this speed also the current may be 1 or 2 per cent. less than when the lamp is stationary, although the voltage is maintained constant. The rotation, therefore, appreciably increases the efficiency. An explanation of this phenomenon may be given by considering the effects of the centrifugal force on the convection currents of gas inside the bulb and remembering that

the resistance of the hot tungsten filament increases as its temperature increases.

After a few personal notes on Lord Kelvin's powers as a teacher, Dr. Russell concluded with a graceful tribute to the enduring nature of the great man's work.

MOTOR CAR LIGHTING AND ENGINE STARTING

A PAPER entitled "Electrical equipment of a car, with special reference to American starting and lighting systems," by Mr. A. L. Claydon, was read at a meeting of the Institution of Automobile Engineers last week. The author took the application of electric starting and lighting systems as dating from 1912 when the Cadillac Co. adopted the "Delco" outfit of the Dayton Engineering Laboratories Co. This system consists briefly of an arrangement of clutches which allows a single armature to operate at comparatively low speed as a generator or at comparatively high speed when being used as a motor. The alternatives to this system are the use of a single machine with an invariable gear for both purposes or the use of two separate machines, one a dynamo and the other a motor. On account of the large size of armature required to give the necessary starting torque when geared sufficiently low to run with the full engine speed as a dynamo, it is not practicable to make the single machine equipment appreciably lighter than that with two units, and this together with difficulties in connection with the gearing for so heavy an armature has led to the two-unit system being more generally adopted on American cars. Incidentally the author remarks that 6 volts is the standard pressure for car lighting in America, while 12 volts is more usual in the case of British-made equipment.

The principal problem encountered in the design of car-lighting is the regulation of the voltage. In the early days a popular method was to prevent the speed of the armature from exceeding a predetermined amount by a mechanical governor which caused a clutch to slip or disengage at a set speed. A modification of this idea was to use the governor to switch resistance coils into the field windings of the dynamo, thus cutting down the voltage while still allowing the armature speed to increase. These mechanical control machines have not prevailed, mainly because of the difficulty in maintaining the accuracy of a high speed mechanical governor. Also, purely electrical methods for governing the voltage are mostly lighter than the mechanical methods and they are less subject to wear, which is another great advantage in their favour.

In an electrical system for automobile lighting we are bound to have a practically constant voltage in the main circuit. But we need different amounts of energy according to the state of affairs at the moment. Suppose that we have only the small lamps in use, we need a definite voltage and only a small current, but if we now switch in the large lamps we need more current at the same voltage. Again, if the battery charge is low we need current to bring it back to the fully charged state, and the nearer it approaches to the fully charged condition the less current do we need. This means that the energy demanded on a car is always fluctuating while the voltage demand is constant.

The author then explained the auxiliary brush system of voltage regulation, showing how, owing to the angular shifting of the axis of the field with increasing current by distortion due to armature reaction it was possible to adjust the position of the subsidiary brushes so that the current in them will reverse its direction at any desired speed of armature revolution. Thus if these brushes feed an auxiliary field winding, a positive or negative correcting excitation can be superposed upon the main excitation according as the speed is above or below the normal and an approximately constant voltage maintained within certain limits of speed variation. In practice the fourth brush is dispensed with by connecting a third brush in the middle of the main shunt winding. The potential of this brush will decrease, reverse, and then increase again exactly as though the second subsidiary brush was opposite to it.

Another more usual method is to wind the magnets with a plain shunt coil between one main brush and the auxiliary brush, leaving the other main brush unconnected with the winding. A somewhat different system without auxiliary brushes employs a compounding coil in the accumulator circuit shunted by an iron wire "ballast" resistance (called in America a "bucking" coil).

The most recent scheme for regulating output is to use a plain shunt winding and no auxiliary coils, but to have an external resistance that can be put into circuit with, or withdrawn from, the shunt coils automatically, by means of a vibrating contact regulator on the same principle as the well-known Tirrill regulator employed in central stations. This system can be employed for either current or voltage regulation.

The author quotes some remarks of Mr. J. Bijur in America. Mr. Bijur criticises third brush or inherent regulation, saying that, with it, it is difficult to make a construction in which the control of the machine is responsive to anything but current in some circuit. That is to say, either in the dynamo output circuit or in the battery branch circuit. He added that to make such a machine regulate in response to its potential alone was so difficult and costly that machines of this type have not come into commercial use. He stated as his opinion that regulation cannot be accomplished within reasonable space and at reasonable cost without using a separate regulator. In summing up the advantages of current and voltage regulation, he said that where the electrical load is large a machine should be able to supply high current to take care of this load. To re-charge a battery which has been subjected to this load, voltage regulation is desirable even though it cost more than current regulation. On the other hand, when the lighting load is not very high, and the starting load constitutes a larger factor in the total current consumption, then current regulation can be employed to good advantage. There is, of course, another automatic device required in connection with dynamos made of units separate from the starting motor. With a single-unit machine, the battery current being switched on causes the armature to act as a motor until such speed is reached that the current reverses and the machine commences to operate as a dynamo, thereby charging the battery. With a dynamo which is a dynamo only it cannot commence to generate battery voltage until a certain armature speed is reached. It is therefore necessary to have an automatic switch which will cut in the generator at the proper speed. In the early days of lighting equipment, these automatic switches were somewhat unreliable, and the firm of C. A. Vandervell & Co., Ltd., it will be remembered, preferred to use an overrunning ratchet clutch so that the generator motored freely when current was first switched on, the clicking sound of the ratchet calling the attention of the driver to the state of affairs. It seems, however, that automatic switches have now reached a stage in development where they are as reliable as any other part of the car.

The author then discussed some points connected with the suitable cut-in speed, mechanical gearing, etc. For starting motors an ingenious device is the Bendix pinion, which is mounted on a travelling nut having a weight on one side. When current is switched into the motor, thereby causing the armature to turn, the weight on the pinion restrains it from revolving, thus causing it to screw up on the thread and thereby be drawn into mesh with the flywheel gear. Directly the engine starts, the flywheel runs faster than the motor would drive it, and this unscrews the pinion causing it to disengage. Even with this device, however, there is a certain amount of shock as the pinion takes up the drive.

Electrically, the design of a starting motor is very simple. It needs to be merely a simple series-wound machine which will produce sufficient torque with the current available to revolve the engine at a speed adequate to start it. It is in use for such short periods of time that its efficiency hardly has to be studied. American manufacturers having developed the dynamo and battery lighting outfit to a satisfactory degree of reliability, are now abandoning the magneto for ignition and returning to the battery and coil, and the paper concludes by discussing mechanical details of some designs of contact maker used in these new American systems of battery ignition.

Obituary.—By the death of Professor H. M. Waynforth—until recently Professor of Engineering in King's College, London—engineering teaching has suffered a great loss. He died on Sunday, November 5th, after a long illness. He was appointed Assistant Professor of Engineering in 1902 and University Professor in 1912. The present syllabus for the B.Sc. degree in Engineering owes much to his energy and professional ability. An eminently practical man, he laboured assiduously to keep the syllabus as practical as possible, and at the same time to maintain a high standard of academic attainment. His lectures at King's College were marked by great freshness and vigour, and his breadth of mind and cordial sympathy endeared him to all his students. His loss will be felt by his old colleagues at King's College and in the University of London, but he will be especially mourned by the large number of King's men who now, on many battle fronts and in the Grand Fleet, are applying the principles he taught so well to the engineering problems of the war.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

ANSWERS TO No. 1,514.

It is proposed to instal a 1,500-ampere hour battery of 122 cells to take the night load of a station, the total generating capacity of the oil sets being 400 kw. and voltage 220. It is possible that the battery would be subjected to a load of 500 for half an hour during the night, the load for the remaining period being much less. Fourteen of the cells will be fitted as "End Regulating," and a booster will be installed for "day charging" the battery. For this purpose it is proposed to use an existing booster set consisting of a shunt motor driving two series boosters each 30 volts at 600 amps., and to rewind these boosters to give 90 volts when in series. Is it considered practicable to increase the speed of the set to obtain the required 50 per cent. increased volts and thereby avoid rewinding the armatures? Is it essential to rewind the series booster fields to be of the shunt type, and should the boosted volts be regulated by means of the motor or the generators? If the set was arranged to be reversible in lieu of having "end regulating" cells, state what precautions must be taken in designing the switchgear, having in mind particularly the satisfactory operation of switching the boosters in and out of circuit whilst a current is flowing through the apparatus. "BOOSTER."

The first award (10s.) is given to "FLASH" for the following reply:—

Considering the case of the boosters required solely for hand operated charging purposes with "end regulating" cells, they will essentially have to be shunt wound. The existing machines, proposed to be used, were originally designed for series boosters, and will therfore have a low flux density, in order to give a straight line characteristic, but for the present charging boosters this feature is not essential, and the flux can probably be increased 20 per cent., towards bringing the volts up to 45. The remainder could be obtained by increasing the speed of the motor 25 per cent. This would obviate the necessity of re-winding the armature. In order to give a boosting voltage variation of 0-90, the fields will have to be separately excited from the 220 volts supply, and a potentiometer regulator used, to obtain very fine regulation between these limits.

The principle features of the swichgear required are:—

1. An overload and reverse-current circuit-breaker for the booster circuit. This will protect the booster and prevent the battery feeding back on the mains, and running the booster as a motor up to a dangerous speed, in the event of the live volts dropping and the motor being cut out of circuit.

2. A single-pole change-over switch arranged with charging and discharging positions.

3. One potentiometer regulator controlling both booster fields.

4. Battery end regulator of the usual type, to cut in additional cells without dead short-circuiting them, and at the same time without interrupting the main circuit.

The motor switchgear should consist of a motor-starter, D.P. circuit-breaker, and regulator.

Considering the case of arranging the boosters as reversible sets, it must be borne in mind that the load of 500 kw., *i.e.*, 2,270 amps., for half an hour is impossible for a machine of 600 amps. capacity, even as an overload, but this difficulty can be overcome by connecting the machines in parallel. A load of 1,135 amps. or 95 per cent. overload for half an hour, should be within the province of these boosters. With regard to the voltage required under these conditions, it is significant to point out that, to cope with any condition between charge and discharge, the voltage required from the booster is least when the number of working cells is reduced to 105, viz.:—

Boosting voltage per cell $= 2{\cdot}4$
Lowest discharge limit $= 1{\cdot}8$.

Charging: $105 \times 2{\cdot}4 = 252$ volts. Positive boosting volts $= 32$.

Discharging: $105 \times 1{\cdot}8 = 188$ volts. Negative " " $= 32$

Any number of cells above or below 105, would require the booster to give a greater range than 32 volts.

No doubt exists of the possibility of these duplicate machines running in parallel satisfactorily, as the writer knows of boosters running under similar conditions in actual central station practice, but to ensure the current being equally divided between the two machines, a separate potentiometer regulator should be provided for each field. The regulation of charging and discharging will, of course, have to be hand operated.

The connections of this arrangement are as shown in Fig. 1,

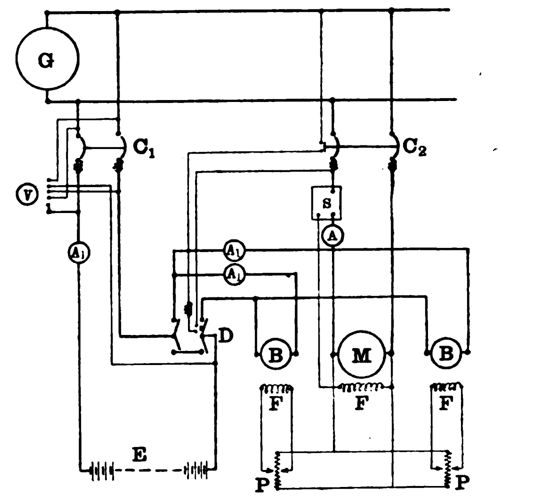


FIG. 1.

A. Ammeter.
B. Boosters.
C_1. D.P. Circuit-breaker.
C_2. Do. with Interlock.
D. Automatic Change-over Switch.
E. Battery.
F. Shunt Fields.
G. Main Generator.
M. Booster Motor.
P. Reversible Potentiometer Regulators.
S. Motor Starter.
V. Voltmeter.

which is self-explanatory, but the particulars of the switchgear to be especially pointed out are as follows:—

(D.) A double-pole automatic change-over switch in the booster circuit, connected so that when in the top position the boosters are in circuit, and in the bottom position the battery is direct on the line.

The function of this switch is to safeguard the boosters if a fault occurs on the set by cutting it out and connecting the battery direct on the line, thus preventing any interruption to the supply.

The switch is held in the charging position by means of a catch operated by a shunt solenoid which is connected to the motor circuit-breaker (C_2); if this breaker trips, the solenoid circuit is broken, and the change-over switch drops into the bottom position. The switch does not in any position break the main circuit, always making contact on the one side before leaving the other. The very short period during which the boosters are short-circuited should not injure them.

(A.) Ammeters, the meters marked A_1, should have centre zero scales to indicate whether charging or discharging.

(C_2.) Motor D.P. circuit-breaker with an interlock for the solenoid controlling switch D.

(V.) The voltmeter should be provided with a small three-way D.P. switch for paralleling purposes.

The second award (5s.) is given to "PANSY," who writes as follows:—

The problem of adapting a generator, built for a certain pressure and current, to some other value of pressure and current, is one to which a satisfactory solution can only be found by careful consideration of the mechanical and electrical features of the machine. To what extent the speed may be increased depends upon what margin of safety the armature and other rotating parts have over the stresses due to centrifugal force; alterations to the field strength are limited in one direction by the degree of saturation of the field

magnet and in the other by the risk of sparking at the brushes. While it is impossible to propound a cut-and-dried scheme for the adaptation of the proposed boosters to the higher voltage without far more information about them than we are given, it is quite permissible to say definitely that the voltage cannot be increased 50 per cent. by an increase of speed alone. To do this it would be necessary to raise the speed 50 per cent.; such an increase is excessive and dangerous, meaning, as it does, that the centrifugal stresses would be multiplied $2\frac{1}{4}$ times, so that, apart from electrical considerations, mechanical limitations forbid such a course. A small increase in speed, say 10 or 15 per cent., might be admissible, and it is quite possible to obtain the remainder of the increased voltage by fitting stronger field windings, providing

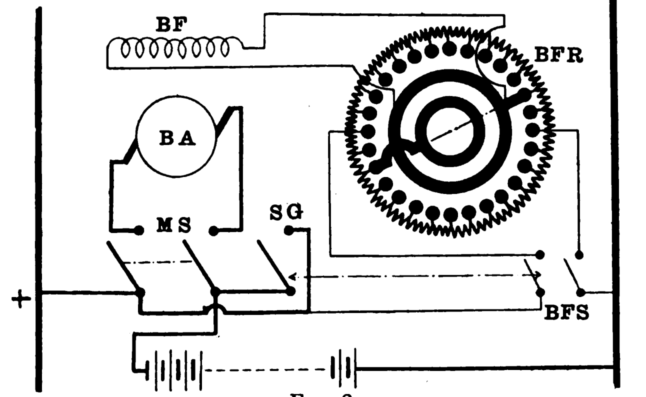


Fig. 2.

that the present flux density is low enough to give a sufficient margin for this to be done. The armature winding would then remain unaltered, and the machine would be still capable of giving an output of 600 amps. at the higher voltage.

If the present series wound field coils are retained it will be found that the regulation of the machine will be very unsteady, the reason being that any variation in the charging current will cause a similar variation in the strength of the booster field, and therefore in its voltage; thus, of course, the original disturbance tends to become rapidly aggravated. Very large fluctuations may occur, even to the extent of the battery motoring the booster, which would, in that event, race with disastrous results. For this reason the field should be separately excited from the main bus bars. The chief part of the regulation of the booster voltage should be effected by means of the booster field regulator; but if the motor be regulable, a small economy can be obtained by running the set slowly at times when only a low boost is required.

In designing the switchgear for a reversible booster, it is

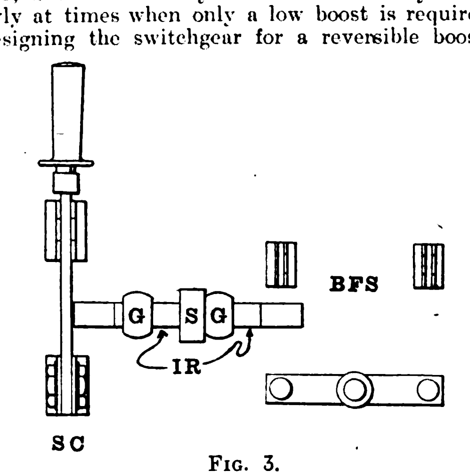


Fig. 3.

necessary to provide against the possibility of closing the booster short-circuiting switch while the machine is excited. A simple arrangement to deal with this matter is illustrated in the diagrams given herewith. Fig. 2 gives a skeleton diagram of the connections of such a booster, as commonly used: BA is the booster armature; BF, the booster field; BFR the booster field regulator; BFS the booster field switch —this being interlocked with SC, the short-circuiting switch, so that both cannot be closed at the same time; MS is the main booster switch. The booster field regulator is often made as shown, of the potentiometer type, and is capable of acting as a reversing switch. Fig. 3 shows a method of interlocking the switches SC and BFS. IR is the interlocking rod, which is able to slide in the guides G, the amount of its travel being limited by the stop S. Its ends are made of insulating material, so as to obviate any risk of short-circuiting the two switches. As shown in the figure, the short-circuiting switch SC is closed, the interlocking bar having been slid to the right, thus making it impossible to close the field switch BFS. When it is desired to close the latter, the short-circuiting switch must first be opened and the interlocking rod slid to the left, after which the field switch can be closed.

It may not be out of place to mention that if the booster be made reversible a less number of cells can be used, and therefore the increase in the voltage of the existing machine may be less. By using 110 cells the battery would be capable of dealing with light loads independently of the booster, being simply switched direct on to the bars. The booster would only be used for heavier loads. The amount of boost required in the "charge" direction would be about 65 volts, and in the "discharge" direction about 20 or 25 volts. The capacity of the battery would have to be increased to allow for running the booster during the discharge, the amount of this increase depending upon the probable length of time the booster might be needed and upon the power taken by it.

THE BELFAST ELECTRICITY UNDERTAKING

On p. 429 of our last issue in referring to Mr. T. W. Bloxam's report upon the electricity undertaking, we inadvertently gave the impression that he had suggested two alternative courses of action, viz., extending the present power-house or building a new one, and placing that of extending the present power-house first. Our previous records of Mr. Bloxam's recommendations with regard to the Belfast undertaking show that he has throughout entirely dissociated himself from what is known as the "patchwork policy," but in order to set the matter beyond doubt we reproduce Mr. Bloxam's latest report :—

I have to report as follows with reference to the present position of the electricity works, having regard to new applications for supplies of electricity.

My estimate of the combined demand upon the works, including lighting, power, and tramways, for the coming winter, when the whole of the 13,300 kw. of plant installed is running simultaneously at its full normal rating, leaves a margin distributed over the three systems of about 11 per cent. Our largest generators have a capacity of 1,500 kw., so that the margin disappears if one of these requires to be laid off during the evening load. I would also mention that conditions sufficiently favourable to allow of getting full normal rating from every engine simultaneously seldom obtains in central stations.

These circumstances lead me to anticipate a shortage of electricity during November or December this year, and a more pronounced shortage next year, as I see very little possibility of increasing the plant capacity by them. The effect of this shortage will be a diminished brilliancy of the lighting, motors giving less power, and tramcars slowing down between the hours of 4 and 5.30 p.m., unless the shortage is sufficiently serious to stop the cars altogether. To incur this risk, however, appears to me to be more equitable to the consumers as a whole, rather than to penalise the minority to such an extent as to refuse to grant new applicants any supply at all. I anticipate a good deal of assistance will be obtained by circularising all consumers, particularly after the necessity for curtailment is brought home to them by the first evening's shortage.

In conclusion, I would again respectfully urge the Committee to reopen the question of raising sufficient money to place the electricity supply of Belfast in a secure position to meet not only immediate requirements, but those which will arise as soon as peace is declared.

At the meeting of the Electricity Committee, when this report was considered, the Town Clerk reminded the Committee that on December 16th, 1914, the Council approved the expenditure of a sum not exceeding £28,391 on the extension of the electricity works, and the Engineer having reported that provided no increased demands were made upon the station the existing plant would meet the next winter's requirements (*i.e.*, the winter of 1915), the Committee recommended the Council to postpone the extension of the electricity works until a more favourable time.

The Committee reconsidered the entire question, and having been advised that there will be a sufficient balance at the credit of the Corporation's consolidated fund to warrant their proceeding with the extension of the electricity undertaking, it was unanimously decided to recommend the Council to authorise the Committee to take into consideration and report upon a complete scheme for the extension of the electricity undertaking, part of which could be taken in hand as soon as the necessary Treasury sanction can be obtained with a view to meeting the constantly increasing demands on the works.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published November 9th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

14,482/15. **Surge Arresters.** British Thomson-Houston Co., Ltd. (*G.E. Co., U.S.A.*) A protective device, more rapid in action than the usual type, particularly in responding to rapidly-rising voltages, comprising a spherical gap spaced apart to permit complete breakdown, with minimum time lag, with a needle-gap and a horn-gap connected in parallel therewith.

14,498/15. **Circuit-breaker.** A. G. Brown, Boveri et Cie. A circuit-breaker with time-limit device for electric currents in which the armature of the electromagnet is connected to an opposing spring through a time-element controlled device, so that when the overload current acts, the armature is attracted against the spring, but is disconnected therefrom when the time-element has elapsed, and the armature then operates sharply with a large force to open the main switch.

14,729/15. **Wireless Telegraphy.** A. W. Long. An improved arrangement of circuits which consists in the employment of an oscillating circuit of low damping, electromagnetically coupled to the exciting and radiating circuits for the purpose of obtaining a single wave of very low damping in the aerial circuit under certain conditions of coupling.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Dynamos, Motors, and Transformers: Thordarson [Transformers] 13,586/15; British Thomson-Houston Co. (*G.E. Co., U.S.A.*) [A.C. motors] 15,186/15.

Electrometallurgy and Electrochemistry: E. Reuss and V. Roberts [Electrolytic apparatus for laundry purposes] 1,628/16 (*101,830*).

Ignition: A. T. Austin [Sparking plugs] 3,062/16 (*101,828*).

Instruments and Meters: Landis & Gyr [Supply meters] 2,600/16 (*100,109*).

Switchgear, Fuses and Fittings: Siemens & Halske A.G. [Relays] 869/16 (*100,262*); W. Barraclough [Switchgear for transformer starters] 9,139/16 (*101,853*); British Westinghouse Elect. & Mnf. Co. [Time-limit relays] 9,826/16 (*100,892*).

Telephony and Telegraphy: Relay Automatic Telephone Co. and Aitken [Automatic telephones] 15,287/15.

Miscellaneous: British Thomson-Houston Co., (*G.E. Co.. U.S.A.*) [Ship propulsion] 15,008/15; Wilson [Electric welding] 17,834/15.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Arc Lamps, &c.: D. F. Comstock [Arc control] 14,936/16 (*101,885*).

Ignition: J. Bethenod and E. Girardeau [Magnetos] 12,793/16 (*101,865*).

Insulation: E. Haefely & Cie A.G. [Insulation of electrical apparatus] 10,184/16 (*101,861*)

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

25,526/02. **Instruments.** J. W. Record and H. E. Trent. Sector-shaped edgewise switchboard instruments with scales set at an angle so as to be visible from the side or the front.

25,658/02. **Wireless Telegraphy.** Marconi's Wireless Telegraph Co., Ltd., and C. S. Franklin. A system permitting of the employment of an existing permanently-earthed structure as an aerial.

The following are the more important Patents that have become void through non-payment of renewal fees.

Electrometallurgy and Electrochemistry: Rudge-Whitworth, Ltd., J. V. Pugh, and H. L. Heathcote [Circulation of electrolyte in nickelplating vats] 16,648/04; British Thomson-Houston Co. [Electrolyte for aluminium condensers and rectifiers] 15,792/08.

Switchgear, Fuses, and Fittings: A.E.G. [Cut-outs] 15,664/08; H. R. Schultz [Circuit-breakers] 17,274/09.

Telephony and Telegraphy: T. M. de Bingham [Electro-capillary telegraph recorders] 27,862/08; S. Eisenstein [Collapsible masts for wireless telegraphy] 17,215/09.

Miscellaneous: C. G. Major, E. C. and P. H. Stevens [Electric lift control] 15,365/05.

CORRESPONDENCE

ELECTRIC COOKING AND HEATING.

To the Editor, Electrical Engineering.

Sir,—In the account in your issue of November 9th of Mr. Berry's paper before the Association of Supervising Electricians, the following words occur :—"Lighting and heating by means of lamps would be nearer perfection if it were possible to destroy the monotony of the lamp radiator and at the same time increase its efficiency."

The word efficiency is very frequently used in connection with electric radiators, and I am at a loss to know what is meant thereby. So far as our present knowledge goes the whole of the energy due to any form of electric radiator, be it of the radiant or any other type, ultimately becomes heat energy. Thus, in the broadest sense all electric radiators have an efficiency of 100 per cent., and cannot under any circumstances yield anything less than this.

It is evident that Mr. Berry cannot have used the word "efficiency" in this sense, or he would not have referred to the possibility of increasing it. In what sense, then, did he use it? An explicit definition would seem to be required.

Yours faithfully,
William Cramp.

33 Brazenose Street,
Manchester,
November 13th, 1916.

AN ELECTRICAL BATH CHAIR
Is it a Motor Car?

At the Hampstead Police Court last week a summons was heard in respect of an electrically-driven bath chair, which is being put on the market by Messrs. Carters, the surgical engineers, 2, 4 and 6, Cavendish Street, London, W. The magistrate decided that the vehicle comes within the definition of a motor car according to the Motor Car Act, and imposed a fine, at the same time stating a case for the point to be settled. The firm are most anxious that the Act should be amended to exclude little ¼ h.p. vehicles of this kind or that they should be subjected to a very small tax, and that no driver's licence should be regarded as necessary.

The vehicle in question resembles a bath chair in appearance. The drive is by a small vertical shaft motor, worm-geared to the swivelling pair of small front wheels, steered by a liner handled by the occupant in the usual way, which swings the whole of this little fore-carriage. The 44-volt battery is under the seat and the control lever by the right hand. The maximum speed is five miles per hour, and the chair is said to be able to run twenty miles on one charge.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"The Loose Leaf Laboratory Manual : Electrical Measurements and Testing. Direct and Alternating Current." By C. L. Dawes. 44 leaves. 10½ in. by 8 in. 52 figures. (New York : John Wiley & Sons. London : Chapman & Hall, Ltd.) 3s. net; by post 3s. 3d.

[A series of sheets each describing a laboratory experiment by the instructor in electrical engineering at Harvard University.]

"British Opportunities in Russia." By L. A. Rojansky. 11 pp. 7¼ in by 5 in. (London : Anglo-Russian Translations Bureau, Ltd.) 2d. net; by post 3d.

[The vast opportunities for trade with Russia are demonstrated by the aid of statistics.]

ROTARY CONVERTERS

A GREAT deal of attention has been paid for years past by the Westinghouse Electric and Manufacturing Co. to questions connected with rotary converter design and operation, and the great success with which these problems have been attacked is shown by the large number of rotary converter contracts with which the firm has been entrusted. A quantity of interesting and useful technical information as to rotary converters and their use is contained in an illustrated "instruction book" on the subject which the company has just issued. A general description outlines the points wherein rotary converters differ from other commutator machines, mentioning particularly the heavy damper windings fitted to each of the main poles for the prevention of "hunting," the arrangement of the slip rings, etc.

The synchronous booster type of converter has practically superseded all other types for securing a greater variation in direct-current voltage than is practicable with reactance and variable field excitation in the ordinary form of converter. In construction, it is the same as a standard converter, but a revolving armature synchronous alternating-current generator or "booster" is added. The booster is placed between the converter armature core and the collector rings. By varying the excitation of the booster, its armature voltage may be added to, or subtracted from, the line voltage and so change the direct-current voltage when running a.c.—d.c., or the a.c. voltage when running d.c.—a.c. This variation is usually done by hand, but may be done automatically.

Where rotaries are required to run inverted, *i.e.*, d.c.—a.c., an exciter is direct-coupled so that the machine when supplying a.c. power to a system by itself may not speed up unduly on account of a load with a lagging power factor coming on. The exciter is so designed that its voltage increases very much faster than in proportion to its speed, and so offsets to a large extent the weakening of the rotary field due to the lagging current. In cases where the rotary has to run either d.c.—a.c. or a.c.—d.c. the exciter is used for field excitation in both cases, but with the difference that when running d.c.—a.c. its rheostat is practically all in circuit, while when running a.c.—d.c. it is practically cut out of circuit.

Practical hints are given regarding the erection of rotary converters, drying out and testing the insulation and connecting of these machines. The functions of the equaliser leads and series diverter are explained and the precautions that should be observed when connecting up for parallel running are set forth. Other interesting points are the methods of finding the correct running position of the brushes, including the "kick neutral" method based on the fact that when the field circuit of any direct-current machine is opened an induced voltage is generated in the armature windings. In case the brushes are in the exact neutral position the resultant voltage so generated is zero.

Instructions are also given regarding the adjustment of the commutating full field should this be necessary.

As a safeguard against over-speeds, a speed-limit device is attached to the oscillator end of the shaft, consisting of a spring closed switch. When the converter reaches a certain speed above normal, a centrifugal governor mechanism operates the switch and opens the circuit-breakers, thus cutting off the converter from its source of supply. All speed-limit devices are set and tested at the works.

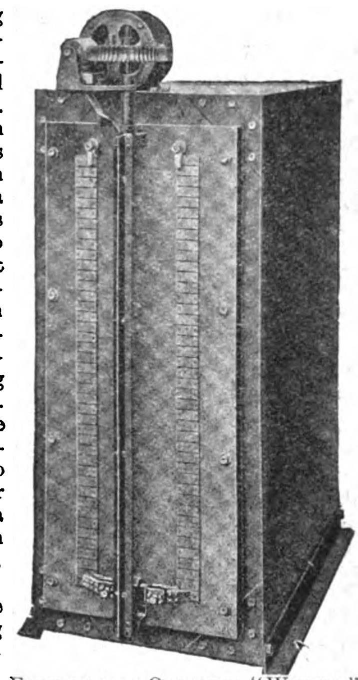
Another special feature of Westinghouse machines is the mechanical oscillator, which is a self-contained device carried at the end of the shaft to eliminate brush grooves in the commutator due to the armature running in a fixed position. The working parts consist of a hardened steel ball and a hardened steel plate with a circular ball race backed by a spring. This is so mounted that the face of the plate is not quite parallel to the face of the end of the shaft. The steel plate is adjusted so that the ball when at its lowest position is in light contact with the race and shaft. As the armature revolves the ball is carried upward and, owing to the convergence of the steel race and shaft face, the spring is compressed. The reaction of the spring forces the armature axially away from its natural position and allows the ball to drop back to the lowest point of the race. The frame of a self-contained converter is dowelled to the bedplate at the works in such a position with respect to the armature core that there is a magnetic pull holding the shaft end against the oscillator. Therefore when the oscillator ball forces the armature away from the oscillator this magnetic attraction returns the armature to its original position and the cycle is repeated.

The section of the book relating to operation deals among other subjects with the effect of power factor on armature heating, automatic compounding, the effect of the series field on fluctuating roads, parallel operation on the d.c. and a.c. sides, circuit breaker protection, etc., and the subject of starting rotary converters is very fully treated.

A portion of the book as useful as any to those in charge of rotary converters is that at the end, devoted to care and maintenance, particularly as regards the upkeep of commutators. The book is well illustrated, and contains numerous diagrams of connections.

MAIN REGULATORS

FROM time to time we have illustrated various patterns of main regulators manufactured by The General Electric Co., Ltd., of 67, Queen Victoria Street, London, E.C., and Witton, Birmingham. All those previously described have been hand-operated, but the one now illustrated, forming part of an important contract for a large municipality, is driven by a small "Witton" electric motor. This motor is mounted on top of the regulator, and is controlled from the main switchboard by means of a pair of small push switches forming one unit, and so arranged that they cannot be left in the "on" position. There is one switch for each direction of operation, and an interlock prevents both switches being operated at the same time. To prevent damage to the motor when the main regulator control has come to the end of its travel, either at the top or the bottom, a resistance is inserted in series with the motor, and, in addition, a flexible coupling is provided between the motor and the worm driving the gear wheel. This construction avoids limit switches, and is very simple and effective. The regulator itself is of the Witton rectangular pattern, with grid resistance, one of a wide range of types which are manufactured by the G.E.C.



ELECTRICALLY-OPERATED "WITTON" MAIN REGULATOR.

X-RAY ACCESSORIES

AN illustrated pamphlet from Siemens Brothers and Co., Ltd. (Woolwich), deals with a special piece of apparatus known as the "Skiafix," designed for fixing and holding patients during radiographing. This appliance is useful in cases where radiographing is required and the patient has no power to control movements. When suitably clamped the "Skiafix" enables any limb to be kept perfectly steady and free from involuntary movement. Moreover, limbs which cannot be rotated by voluntary action on the part of the patient can be rotated by means of the clamps holding the extremities. The apparatus also enables radiographs to be taken in two directions without moving the limb; and many cases which cannot be removed from stretchers can be radiographed without removal with the utmost ease.

Electric-Light Switching Competition.—The result of the first batch of examinations in electric-light switching is as under, the names being given in order of merit:—*Advanced Grade Certificates.*—H. Hanks (Birmingham), T. C. Hodges (London), S. Frankland (E. Morton, Yorks.), L. Thomas (Rugby), T. Doyle (London), H. Cunnick (Swansea), J. W. Hiron (London). *Intermediate Grade Certificates.*—H. Grimshaw (Golborne, Lancs.), W. A. McCall (Blackburn), W. E. Fairchild (Newark), C. R. Gunn (Liverpool), R. Maynard (Cleethorpes), J. J. Rogers (Dundalk), K. G. Ferguson (London), A. Holroyd (Port Clarence). *Preliminary Grade Certificates.*—A. Doyle (Bexhill), J. Moran (Storling, near Bury), "Winnie" (London), C. G. Ovens (Manchester), P. Carroll (Drumcondra), J. C. Gale (Eastbourne), C. H. Bull (Blaina, Mon.). *Extra.*—A. V. Harris (Waltair, India).

Those desirous of particulars of these exams., and of the subject to which they relate, should write to Messrs. A. P. Lundberg and Sons, 477–489 Liverpool Road, London, N. It may be mentioned that the examinations are free, the papers being worked at home. Further, an applicant is given an immediate opportunity of trying his hand at a paper, without waiting for the next regular competition for prizes, the date of which is yet undecided.

LOCAL NOTES

Ipswich: *Electricity Accounts.*—The financial result of last year's working of the electricity undertaking was a deficit of £1,064. Capital expenditure was defrayed out of revenue to the extent of £1,022, making the total deficit £2,087, against which the department has received aid from the rates, originally earmarked for the tramways, to the extent of £2,100. Whilst the units sold show an increase of 26 per cent., the cost of coal shows an increase of 87 per cent., or £4,421.

Mr. F. Ayton, in the course of his report, says that the year has been full of difficulties, principally in connection with labour. It has been most difficult at times to deal with the coal supply, especially the unloading of the coal and in getting supplies into the boiler house. At times also the difficulty with labour seriously jeopardised the continuous working of the plant. The position had already become serious in the closing months of the financial year 1913–14, so that tenders were invited for coal handling plant, and that submitted by Messrs. Fraser & Chalmers was accepted in February, 1915. In spite of the unassailable reasons put forward as to the urgency of the matter, the Local Government Board declined to sanction the scheme, and, therefore, for a time it had to remain in abeyance. Matters got worse with the increasing consumption of coal. Finally the Ministry of Munitions and the Admiralty took the matter up with the Local Government Board, with the result that in the autumn of 1915 sanction was given to the work being proceeded with, but owing to difficulties in getting men and materials, the plant is only now in course of erection and half-way towards completion. There will be an appreciable saving in the expenses of dealing with the coal when we get this plant working, and a source of great anxiety to the staff will have been removed. At times also difficulty was experienced in getting a proper quantity of coal, with the result that on one occasion the stock was reduced to a very dangerous level. Fortunately the Admiralty took the matter up, and at the present time there is a reasonable stock.

London: *Hackney: Electricity Charges Increased.*—The Council has decided to increase the charges for current from the December quarter.

Luton: *Linking-up.*—Mr. W. H. Cooke, the Borough Electrical Engineer, has been asked to act as convener for the Committee on Linking-up for the South Midland area, in which Luton is included.

Manchester: *Street Lighting.*—A correspondent writing in the *Manchester Guardian* makes a suggestion with regard to street lighting. He says: Has not the time come for putting the business of street lighting on a practical basis? Normally the street lighting arrangements are in the hands of a special committee of the Corporation, consisting of five members of the Gas Committee, five of the Electricity Committee, and five of the Finance Committee. The last group is supposed to hold the balance between the other two. The Committee, it is said, has not met once this year. Shortly before the war one read that its members had a tour of inspection. They saw some streets lit with electricity and others with high-pressure gas. But nothing, apparently, came of the inspection. It has been understood that in due time the comparative result, in cost and illuminating power, would be made public. So far, however, that result (if it has been ascertained) has not been announced. Obviously when two Richmonds are in the field bickering and jealousy are inevitable. Should not the City Council, when they appoint committees next Thursday (to-day), discharge the old Lighting Committee and appoint a body of men who are not prepossessed in favour of either gas or electricity, and who will decide what, in their judgment, is best for the people? Of course, while the war lasts, they must submit to the rule of the Chief Constable, as the agent of the military authority.

APPOINTMENTS AND PERSONAL NOTES

The Edison Swan Company requires a manager for their lamp works at Ponders End (see an advertisement on another page).

Mr. H. H. Holmes, sales manager in the Marylebone electricity undertaking, has been offered an appointment in the Army with a commission. He reports for duty on the 20th inst.

Mr. T. K. Richardson, station superintendent at the Marylebone Electricity Works, has resigned owing to ill-health.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Finchley.—Extensions to the electricity plant estimated to cost £35,000 are contemplated after the war.

South Africa.—The Cape Town Council requires a supply of electric motors and starting panels. The specifications may be seen at 73 Basinghall Street, E.C. Tenders by January 5th, 1917.

Sunderland.—The after-war works proposed by the Corporation include considerable extensions of mains.

York.—New mains are included in the list of post-war works submitted to the Local Government Board.

Miscellaneous

South Africa.—The Johannesburg Council requires 1,427 house service meters, 7 switchboard meters and 100 time switches. Further particulars at 73, Basinghall Street, E.C.

TENDERS RECEIVED AND ACCEPTED AND ORDERS PLACED

Shanghai.—The Municipal Council of the International Settlement has ordered Osram lamps for use during the coming twelve months. The G.E.C. Co. of China, Ltd., have also just secured the contract from the Municipal Council of the French Settlement, so that both Settlements of Shanghai are now exclusively using Osram lamps for street lighting.

Watford.—The contract for cable now running with Messrs. Henley's is to be renewed, with a sliding scale to deal with various prices of steel tape used for armoured cables.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Drake & Gorham.—At the annual meeting last week the report and accounts (given on p. 420 of our issue for November 2nd) were adopted. The Chairman, Mr. B. M. Drake, referred to the large amount of Government work being carried out, and also to the fact that the large power station for the United Alkali Co. is now complete. The electric vehicle department is doing well, and congratulations were extended to the Manchester branch on a successful year. In the previous twelve months the branch was somewhat disappointing.

Edison Swan Electric Co.—The report and accounts for the year ended June 30th, after providing for interest on both classes of debenture stock, and depreciation upon freehold properties and plant, shows a net profit of £24,146 12s., which, added to the amount of £4,878 16s. brought forward from last year, makes a total of £29,025 8s. The directors propose to transfer £25,000 to reserve account, and carry forward £4,025. The capital expenditure during the year, before providing for depreciation, has amounted approximately to the sum of £16,000, the major portion of this having been expended upon additional plant and machinery. The Company's trade has shown a further considerable improvement during the past year. In consequence of this expansion, all available cash is required in the business, and considerable further sums could have been profitably employed. In these circumstances, the directors regret that they are not in a position to recommend the payment of a dividend upon the shares. The high cost of labour and materials has again seriously affected the profits derived from the manufacture and sale of drawn wire lamps, it being impracticable to increase the selling price of these to meet such extra cost. The engineering side of the works has been almost wholly employed upon Government work. The export business shows a still further expansion, and this branch of the Company's trade being now established upon a firm basis, it is hoped that when normal times succeed the present, still better results will be obtained.

Price of Copper.—Messrs. George Smith & Son, 5 Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £149 to £152 (last week £143 to £146).

The Union Cable Co.—Answering a question in the House of Commons last week, Mr. Pretyman said that the 96 per cent. of the shares of the Union Cable Co. which were held by the Deutsche-Kabelwerke of Berlin have now been sold to British subjects.

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SUMMARY

IN his Chairman's Address to the Manchester Section of the Institution of Electrical Engineers, Mr. McKenzie touched upon a variety of topics. A large electro-chemical works has been connected to the Manchester undertaking the demands of which will far exceed those of any other consumer, not excluding the tramways. Fuel, large power stations, gas firing, railway electrification, and rate relief out of profits were among the other subjects discussed (p. 440).

A DESCRIPTION is given of the new Clyde Mill Power Station of the Clyde Valley Electrical Power Co., where a portion of the plant has already been put to work (p. 441).

SOME interesting particulars were recently given to the South African Institution of Engineers as to the inefficient working of German electrical machinery (p. 442).

A PROBLEM connected with earthing of the neutral in interconnected three-phase systems is propounded in our Questions and Answers columns (p. 442).

AMONG the subjects of specifications published at the Patent Office last Thursday were transformers, electrical ship propulsion and single-phase motors. Patents connected with miners' lamps and wireless telegraphy expire this week after a full life of fourteen years (p. 445).

THERE was a profit of £6,998 at Greenock last year.—At Newport (Mon.) there was a deficit of £993 (p. 446).

WATER-COOLING plant is required at Hull, and electrical fittings at the Trimdon Colliery, Durham (p. 446).

Cable Makers' Association.—At the invitation of the association, the post of Secretary, which became vacant by the death of the late Mr. A. H. Howard, has been accepted by Mr. Llewelyn B. Atkinson, M.I.E.E. Mr. Atkinson is a director of W. T. Glover & Co., Ltd., and has for the past 13 years been closely associated with the work of the Cable Makers' Association, of which, in the year 1913, he was chairman.

Arrangements for the Week.—(*To-day*), *Thursday, Nov. 23rd.*—Institution of Electrical Engineers. "The Parallel Operation of Electric Power Stations," by J. S. Peck. 8 p.m.

Tuesday, Nov. 28th.—Institution of Electrical Engineers, Manchester Section, at Engineers' Club. "The Parallel Running of Electric Power Stations," by J. S. Peck. 7.30 p.m.

Thursday, Nov. 30th.—Greenock Electrical Society, 22 West Stewart Street. "What is Electricity?" by J. L. Hogg. 7.45 p.m.

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE, S.W.
ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the Week.—Platoon Commander W. J. A. Watkins.

Next for Duty.—Platoon Commander H. de P. Birkett.

Monday, Nov. 27th.—Technical for Platoon No. 9, at Regency Street. Squad and platoon drill, Platoon No. 10. Signalling class. Recruits drill, 6.25—8. Lecture on telephones, 7.30.

Tuesday, Nov. 28th.—School of arms, 6—7. Lecture, 7.15, "Entrenching," Coy. Cmdr. Castell.

Wednesday, Nov. 29th.—Instructional class, 6.15. Platoon drill, Platoon No. 1.

Thursday, Nov. 30th.—Platoon drill, Platoon No. 5 and 6. Ambulance class by M.O., 6.

Friday, Dec. 1st.—Technical for Platoon No. 10, Regency Street. Squad and Platoon drill, No. 9. Signalling class. Recruits drill 6.25—8.25. Lecture on telephones, 7.30.

Saturday, Dec. 2nd.—N.C.O.'s class, 2.30. Coy. Cmdr. Bentley.

Sunday, Dec. 3rd.—Entrenching at Otford. Parade Victoria (S.E. & C.Ry. Booking Office), 8.45 a.m. Uniform, haversacks, water bottles. Midday ration to be carried. Railway vouchers will be provided.

Musketry.—For all Companies see Notice and Tables A and B at Headquarters.

Note.—Unless otherwise indicated all drills, etc., will take place at Headquarters.

Inspection.—The inspection by the County Commandant is postponed for a few days.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

The Indicator Handbook. By C. N. Pickworth. Part I. The Indicator: Its Construction and Application. 142 pp. 7½ in. by 5 in. 92 figures. (Manchester: Emmott and Co., Ltd. Fifth edition. 3s. net; abroad 3s. 5d.

THIS well-known and deservedly popular practical handbook on the indicator for steam and internal combustion engines has now reached its fifth edition and is thoroughly up-to-date. New editions include a note on integrating indicators, and some recently introduced forms of external spring instruments. In this volume the construction and application of the indicator are dealt with. The analysis of the indicator diagram is reserved for a companion volume.

The Fan. By C. F. Innes. Revised by W. M. Wallace and F. R. Jolley. 302 pp. 7½ in. by 5 in. 151 figures. (London: The Technical Publishing Co., Ltd.) Second edition. 8s. 6d. net; abroad 9s. 2d.

THIS is a revision of a work by Mr. C. F. Innes published in 1904, presenting a theory of the action of centrifugal and axial fans and air propellers, embodying a mass of experimental data relating to different types of fan and a good deal of practical information regarding fan design. In addition to careful revision of the text, almost all the figures have been redrawn and a valuable chapter has been added dealing with recent practice, mainly in the construction of fans and centrifugal compressors.

The A.B.C. Guide to Patents for Inventions. By R. E. Phillips and A. M. Flack. 66 pp. 8¼ in. by 5¼ in. Second edition. (London: Phillips.) 6d. net; by post, 8d.

The method of grouping the matter in paragraphs arranged under alphabetical headings adopted in this book has certain advantages. The headings, of course, constitute an index, as the paragraphs do not run in logical sequence, and from this point of view there is the possible drawback that no two persons compile an index on exactly similar lines. As, however, the headings are for the most part terms well known in patent procedure, perhaps not much is lost on this account. The novice, however, might be troubled slightly, although a little familiarity with the book soon enables one to find what is wanted.

Hill's Polish-English and English-Polish Vest Pocket Book Dictionary, with Conversation and Idioms. By F. B. Czarnomski. 382 pp. 5½ by 2½ in. (London: L. B. Hill.) 1s. net.; by post, 1s. 2d.

This addition to a well-known and convenient series of pocket dictionaries deals with a language likely to become of increasing importance to commercial men and others, and contains, besides the dictionary proper, a useful series of phrases, &c., and a key to the pronunciation, which is not so complicated as the appearance of some of the words would suggest.

(*For further Reviews see p.* 445.)

THE I.E.E. MANCHESTER SECTION

Mr. McKenzie's Review of the Industry

IN his inaugural address to the Manchester Section of the Institution of Electrical Engineers on the 14th inst., the chairman, Mr. A. E. McKenzie, chief assistant engineer to the Manchester Corporation Electricity Department, dwelt briefly on several general topics more or less the direct outcome of the war.

Organisation of Engineering Industries.—After reviewing the work that has been done with the object of reorganising British industries after the war, the opinion was expressed that the engineering firms of this country can supply all our requirements of equal, if not better, quality than our Continental neighbours from a turbo-alternator to a lamp, if the purchasing engineers of this Empire remember the sentiments that most of us now feel. The matter, however, was one both for the purchasing engineers and the manufacturing engineers. It was not intended to imply, however, that British manufacturers had in the past done all that they should do to cater for the requirements of the electrical engineering industry. One case was cited, namely, that of turbine rotor discs. Practically all these came from abroad before the war, mainly because the steel-makers of this country would not adapt themselves or lay their works out for this class of business. This was an important case, because if British steel-makers did not take up this line it was bound to have a marked effect in determining the type of turbine to be employed in the future, especially for large units.

Linking-up.—The progress of the linking-up campaign, which has been mentioned in our columns from time to time, was sketched, and in Mr. McKenzie's opinion the personal factor is a very important one in cases where negotiations for arrangements have to be carried out. Some engineers are more easily converted than others, and they might be afraid of loss of prestige and even of position through the association of their undertakings with larger schemes. The latter view, however, is not really a sound one, because whilst the distribution of electricity remains in the hands of each undertaking there will still remain scope for the services of an engineer-manager. At the same time a certain amount of give-and-take is essential in the national interest. With regard to the Lancashire and Cheshire scheme Mr. McKenzie holds the view that the Government should assist to some extent in the raising of the necessary capital, a view that was expressed in the report referred to recently in our columns.

The Summer-Time Act.—The general effect of this Act was outlined, and so far as it has been possible to institute comparisons, at Manchester it is estimated that the reduction in lighting output at the Stuart Street station during the period covered by the Act was equivalent to 1 per cent. of the total output, whilst the consequent saving in coal was about 600 tons. At the other Manchester stations the reduction was approximately $1\frac{1}{4}$ per cent. of the output with a saving in coal of about 400 tons.

Development of the Manchester Undertaking.—The following figures relating to the Manchester electrical undertaking are interesting. The total plant capacity installed at the three stations to date is 73,500 kw., and when the plant now under construction is completed this will be increased to 93,000 kw. Included in the latter is another 15,000 kw. turbo-alternator for Stuart Street and a 10,000 kw. turbo-alternator for Bloom Street. These sets will displace reciprocating units of 3,750 kw. and 1,800 kw. respectively. Mr. McKenzie recalls a well-known central station engineer saying to him about twelve years ago that it was a mistake to put down such a large unit as a 3,750 kw. set, and that 1,500 kw. sets would have been a wiser policy. During the year ending March last the present 15,000 kw. set at Stuart Street generated 90 million units, whilst the total output of the undertaking for the year toSeptember last was 196 million units, an increase of 27 millions, or 16 per cent. over the quantity generated during the previous year. This increase, however, will be greatly exceeded during the current year, and it is predicted that the annual output from the Manchester stations within the next five years will reach 300 million units.

Electro-Chemical Demands.—One direct outcome of the war is the evident desire to render the country less dependent on foreign supplies of certain materials, and in no case is this more marked than as regards certain chemical productions. Steps are already being taken, especially with electro-chemical plants, many of which can be adapted to take a restricted-hour supply during the winter months of the year, thus furnishing an ideal load for central stations. One such consumer had just been connected to the Manchester undertaking whose demands will far exceed that of any other on the system, not excluding the entire tramway demand. This supply will be given by the Corporation without the latter having incurred any capital outlay on the plant, because over the peak of the winter load, namely, from 3.30 p.m. to 5.30 p.m., and at other times of severe atmospheric conditions, the consumer in question has arranged to reduce his load to zero if required. Otherwise the demand will be continued day and night. Such desirable consumers are, of course, rightly entitled to the lowest possible rate per unit.

Fuel.—Complaint is made at the meagre assistance which has been given by the Government to electricity undertakings in the matter of coal supply, and there is no doubt that additional legislation is required in the matter. The fuel procurable to-day is inferior to that obtained before the war from the same pits, a large proportion of it being until recent years unsaleable. To burn such inferior fuel called for conditions different from those previously obtaining in most stations, but higher draught and modern grates suggest that frequently the lower grades of fuel can be used economically. The high prices now obtaining for all classes of fuel called for more efficient management of boiler-houses, where it is generally admitted more can be done to improve the economical working of a supply undertaking than in any other department.

Power Stations of the Future.—The large station of the future will have a proportion of boilers gas fired, this proportion being based upon the load factor in such a manner that the extra capital incurred by the installation of by-product recovery plant will be remunerative and the by-products of the bulk of the fuel used recovered. Gas firing has not yet had its fair chance, in that practically every trial has been conducted with Lancashire or water-tube boilers. There is a fine field open for the invention of the large and highly efficient gas-fired boiler. More than usual interest attaches to this subject by reason of the experiments on a large scale that are to be made at the Yorkshire Electric Power Co.'s station at Barugh, near Barnsley, and at the Southwick Power Station of the Brighton Corporation.

Apart from the question of gas-fired *v.* coal-fired boilers considerable attention has been given to the design of new boiler-houses and in the utilisation of larger units, and reference was made to the marked contrast between British and American practice as brought out by Mr. Pearce, the City Electrical Engineer at Manchester, at the I.M.E.A. meeting this year. The proposed use of large gas engine driven generators is now completely a thing of the past. Turbine plants undoubtedly hold the field, and in the future one may confidently anticipate seeing units of 20,000 to 25,000 kw. being installed in some of our large British stations.

Electrification of Railways.—Mr. McKenzie disagrees with those who hold the view that legislation should be passed to standardise one of the existing systems of electric railway working. Without doubt standardisation in regard to railway electrification is desirable, but to standardise any one system at a time when almost daily radical improvements are being made would be a great mistake. If each system is developed and given a fair trial the best will soon demonstrate its superiority over the others, then let the Government legislate to enforce the adoption of this particular system in the future to ensure through running of all railways.

Rate Relief.—The war has served to bring into prominence again the vexed question of rate relief from the trading departments of Municipalities. With a 5s. income-tax the time has come for a drastic revision of the methods followed by many Municipalities of exacting large sums of money by way of rate relief from the trading departments. Most engineers are agreed that the nearer electricity supplies are furnished at cost price the better for the community at large. As an alternative to a system of rate relief it would not be unreasonable for the ratepapers at large—who would receive no direct benefit under a no-rate relief scheme—to stipulate that the supply undertaking should, in addition to providing for debt redemption, at the same time make some provision over an extended period of years for a renewal of the assets of the undertaking when worn out so as to avoid recourse to borrowing.

The Late Prof. Silvanus P. Thompson, F.R.S.—An exhibition and sale of water-colour sketches by the late Prof. Silvanus P. Thompson, F.R.S., will take place at the Alpine Club Rooms, 23 Savile Row, London, W., from Nov. 27th to Dec. 10th.

THE CLYDE'S MILL POWER STATION OF THE CLYDE VALLEY ELECTRICAL POWER COMPANY

THE Clyde Valley Electrical Power Company have now commenced supplying power from the first section of their large new power station near Cambuslang. The building and equipment of this generating station have been carried through with remarkable celerity, work having been commenced on the station foundations during the first week of February of this year, so that within nine months the station has been erected complete and put on commercial load. Due to the great development of the company's operations, following on the heavy demands for power for engineering, shipbuilding, general manufacturing and colliery purposes, the Clyde Valley Company felt constrained to leave no stone unturned to meet the situation. With this object in view, the work was undertaken, despite unfavourable and adverse commercial and labour conditions.

The site selected forms part of that portion of the Duke of Hamilton's estates known as Clyde's Mill, from which the new power station derives its name. It is situate on the south bank of the River Clyde immediately opposite the village of Carmyle. The company have acquired by feu charter the old Clyde's Mill, together with its ancient water rights. Water from the river is used for condensing and make-up purposes, advantage being taken of the syphonic action due to the five-feet fall between the sealed circulating water outlet and the river intake to reduce the power required for circulating water purposes to a minimum. The plant installed is of the most modern description, and conforms with the best modern practice relating to power station design.

The first portion of the generating plant consists of one turbo-alternator of 5,000 k.w. output at 0·8 power factor, the speed of the set being 1,500 r.p.m. The turbine is of the Rateau type, supplied by the British Westinghouse Electric and Manufacturing Co., Ltd. (Manchester), who have already installed five practically similar machines at the company's power stations at Motherwell and Yoker. The set is supplied with steam at 200 lb. per square inch from two 3-drum land type Babcock & Wilcox water-tube boilers, each boiler having an evaporation of 33,000 lb of water per hour. The boilers are equipped with chain grate stokers, integral super-heaters and Green's economisers. A Lassen-Hjort water-softening plant is also in operation. The two boiler-feed pumps are of the turbine-driven centrifugal type, supplied by Messrs. G. & J. Weir, Ltd. (Cathcart), the exhaust from these pumps being utilised for the heating of the boiler feed water in the hotwell. Induced draught is used for the boilers, an electrically driven "Sirocco" fan being installed on each, and one steel chimney 80 ft. high deals with the waste gases from the two boilers. The condensing plant consists of a "Weir" surface condenser, operating in conjunction with dual air pumps of the same make, the circulating water being furnished by a vertical centrifugal pump made by Messrs. Drysdale & Co., Ltd. (Yoker), situate in the dry well near the river intake. At the river intake a mechanically operated screening plant is in operation to ensure that no foreign matter, in the way of leaves, small pieces of wood, etc., gains access to the condenser and water-circulating plant.

The main generator is of the two-pole star-wound type with rotating field, and generates alternating current at 11,000 volts 3 phase 25 cycles, the necessary excitation being supplied from a 60-volt D.C. dynamo direct coupled to the main generator shaft. The star point of the generator windings is brought out and connected to Merz-Price protective gear. The generator windings are kept cool by an electrically driven "Sirocco" centrifugal fan, situate immediately underneath the generator, the fan drawing washed air through a "Sirocco" air washer and forcing this purified air through and around the generator windings.

The control switchboard is at present of the simplest construction, consisting of one panel with synchroscope, voltmeters, power factor meter, ammeter, indicating or recording wattmeters. The outgoing feeders consist of 0·15 sq. in. 3-core E.H.T. paper insulated, lead covered and armoured cables. The generator and feeders are controlled at the station by the latest pattern oil break switches, with Merz-Price and overload trips, these switches, together with the bus-bars and isolating links, being placed in brick cubicles in the basement and close to the control switchboard. The engine-room bay is served by a 30-ton overhead electric travelling crane supplied by Messrs. John Grieve & Co. (Motherwell).

The fuel for the plant comes forward on an elevated railway, the loaded wagons being tipped by an hydraulic ram into the coal hopper or by-passed through the crusher. The coal is delivered into a bucket conveyor, tipping direct into the bunkers above the boilers. The company have under consideration a large coal storage scheme, complete with coal handling plant. The boiler, economiser and generator house buildings are of steel framework filled in with brick, all designed and erected by the Steel Construction Co., Ltd. (Glasgow), a feature in the design being the general effective natural lighting of the entire plant.

The Power Company's staff carried out the complete railway work, river work and general building construction; the river work, which comprised the building of the necessary coffer dams, rebuilding in concrete and extending the main dam, as also the concrete work in connection with the river intake, etc., being carried out under the most adverse circumstances, the spring and summer of this year having been characterised by heavy floods and exceptional rainfall. A successful feature in the carrying out of the constructional work was the employment of women labour, some 20 per cent. of the labour employed on the railway sidings, foundations and general work being of this nature. All the sand required in the carrying out of the building work was obtained from the station excavations, as also the puddle clay for the coffer dams. Further, any excavated material from the foundations was fully utilised on site in the construction of the works' railway tracks. All the plant and labour-saving devices during construction were electrically operated from the company's distribution system, and, to illustrate the low costs of operating such intermittent running plant electrically, it might be mentioned that the entire power costs of the 10-ton derrick crane used by the structural engineers in the erection of the building framework was under £2 for the handling and placing in position of some 250 tons of steel work. The whole of the work involved in the erection of the plant was carried out under the personal supervision of the company's general manager, Mr. David A. Starr, assisted by the chief engineer, Mr. D. M. Macleod, and staff.

The new power station is located in the centre of the company's system, and approximately half-way between the present generating stations of Yoker and Motherwell. Already the company have derived considerable benefit on its distribution circuits through the starting up of the new station, and Mr. Starr and his staff are to be congratulated on the rapid putting into commission of this station and its satisfactory results.

CATALOGUES, PAMPHLETS, &c., RECEIVED

ADVERTISING NOVELTIES.—The F. B. Hall Manufacturing Co. (11 Bruce Grove, Tottenham) send a number of leaflets describing advertising novelties, appointment books, and calendars.

NEW OSRAM LITERATURE.—We have received from the General Electric Co. (Head Office, 67 Queen Victoria Street, London, E.C.) a specimen of the new Osram Folder price list. This is suitable for enclosure in ordinary commercial envelopes, besides being suitable for the pocket. The company is also issuing correspondence cards for use by their customers, and both items bear this year's design, "Osram the Strong," symbolised by an elephant standing on a lamp.

LIGHTING IN PHOTOGRAPHY.—Numbers 1 and 2 of a booklet on "Lighting in Photography," issued by the Westinghouse Cooper Hewitt Co., Ltd. (80 York Road, King's Cross, London), give a large amount of useful information on the subject of lighting in photography generally, and incidentally preach the gospel of the universal use of Cooper Hewitt lamps. This series of booklets is considerably out of the run of ordinary trade literature.

Certified Occupations.—There has been a revision of the age-limits in the list of certified occupations. The most important feature of the revision is that the ages at which reservations begin in certified trades have been generally raised. In no case where an age-limit is specified is the age under 25, either for single or married men. In some instances in the electrical industry an age-limit has been imposed for married men where previously married men were exempt, whilst simultaneously the age-limit for single men in the same occupation has been very considerably raised. The full list is available from the Government printers, or can be supplied from this office.

GERMAN ELECTRIC POWER PLANT IN SOUTH AFRICA

THE following notes on German electric power plant in South Africa, in a recent address on "The Power Supply of the Rand," by the President of the South African Institution of Electrical Engineers, are taken from the *South African Mining Journal*:—

British engineers are no less skilful than their German competitors, and the merits of German design have often been considerably overrated. It is not uncommon to meet with German plant in South Africa which betrays every evidence of scientific knowledge from a purely theoretical point of view, but is hopeless when viewed from a practical standpoint. The winding of a large alternator, for example, is complicated enormously merely to gain some slight benefit in rating, but at the sacrifice of features which are infinitely more valuable to those who will operate and maintain the finished machine. In this connection the following instances, taken from the experience of a large electric power supply company, were cited to show that although two leading German firms were somewhat ahead of British firms in developing electrical plant of the size and voltage required for large power schemes in South Africa, the German firms made many mistakes, and had still to acquire much experience at the expense of their customers:—

Six 4,000 k.v.a. alternators made by a German firm had to be entirely rewound, and seven 12,000 k.v.a. alternators (including a spare stator) had to be entirely rejointed. The smaller machines were originally wound for 10,000 volts, so as to avoid the use of step-up transformers, and the design of these high-tension windings was totally inadequate. Lightning made short shrift of them, but in any event, their life could not have exceeded a few years. On the largest sets the joints between slot bars and end connections overheated very soon after the machines went into commission, and caused a long succession of serious and expensive breakdowns. The design of these joints had to be radically modified, involving a most tedious and costly programme of work.

Numbers of sub-station transformers of 1,000 k.v.a. and 500 k.v.a. capacity, made by the same firm, proved incapable of standing the stresses imposed at times of fault on consumers' circuits. The method of clamping the coils had to be entirely re-designed. The high-tension switch gear for 40,000, 20,000 and 10,000 volts proved lamentably deficient when called upon to meet working conditions on a system of this size and type, and it would be difficult to exaggerate the seriousness of the consequences which ensued. No scheme in the world has had to face such serious switch trouble, and, when approached, the makers could suggest no better remedy than a duplication of all important switches at the expense of the power company and to the profit of the makers. Needless to say, this course was not pursued. The trouble has been almost entirely removed by the application of engineering common sense to the experience gained in practice. It is quite clear that in those days this firm knew very little indeed about the design of high-tension switch gear for large systems.

When asked to advise on the problem of lightning protection, experts (so-called) were sent out by the German firm to report, but, despite all their theoretical argument, nothing of practical value was produced. This problem, like many others which arise in commercial engineering, had to be solved by weighing up experience and avoiding fantastic proposals.

Although the turbines were a good job in many respects, heavy maintenance charges were incurred on account of defective blading. There is no doubt that the firm had but little knowledge respecting the materials best suited to stand the peculiar conditions to which turbine blades are subjected. At one time accumulation of these blading troubles very nearly involved curtailment of supply, but it became clear that some of the defects which were most pronounced originated from faulty design, and these have now been rendered less acute.

The steam pipes, valves and lagging were a most shoddy job. The flanges on the steam pipes were expanded on without riveting, and a serious accident was but narrowly averted at one power-station due to the expansion and consequent withdrawal of one of these flanges. It has been necessary to re-expand and rivet-on every flange of every steam pipe at two power-stations, and the whole of the lagging, which had begun to break away before the pipes were dismantled, had to be scrapped and replaced by material of better quality.

The arrangement and design of three of the electrically-driven compressors at another power-station is a disgrace, and involves excessive cost in upkeep. The arrangement of intercoolers and pipe-work renders it necessary to dismantle the compressor itself before the intercoolers can be cleaned.

Seven 12,000 k.v.a. three-phase transformers made by another German firm had to be entirely rewound. The original windings were deficient in insulation, and the surface of the copper conductors had been burned during the process.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

QUESTION No. 1,516.

It is proposed to link up a 2,000 kw. and a 5,000 kw. station to a 20,000 kw. station, the supply of each station being 440 volt, 3-wire. The two smaller stations are supplied from rotary converters, whereas the large station has ordinary steam sets with separate balancers. The following earthing device is installed at the large station:—Normally the neutral is direct connected to earth, but when a fault occurs a solenoid in the neutral circuit operates and inserts a resistance sufficient to limit the current to 20 amperes.

(1) In view of B. of T. rules should not resistance be modified to allow 40 amps. to flow?

(2) Leakage indicators only are installed at each small station. Should, in addition, earthing arrangements be provided similar in action to that at the large station, but of 4*a* and 10*a* capacities respectively, or does this infringe B. of T. rules?

(3) As under certain conditions each small station will be working isolated, *i.e.*, supplying its own particular feeders, does not this necessitate the earthing arrangements quoted for each station? If so, would it be necessary to interrupt same when linked with main station?

(4) If the main station were direct connected to earth without the intervention of resistance, would the case be altered in any way? I am told that circulating currents might arise, but I fail to see why, since both earthing positions are also *supply* positions. Please explain this, and say if any damage is likely to occur by earthing both positions.

(5) Would any detrimental effect arise from these "circulating currents" if the station had been three-phase, 500 volts alternating, with neutrals earthed?—["B. OF T."]

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

"Principles of Alternating Current Machinery." By R. R. Lawrence. 614 pp. 8¼ in. by 5¾ in. 273 figures. (New York: McGraw-Hill Book Co. London: Hill Publishing Co., Ltd.) 18s. 9d. net.

[A detailed exposition of the principles, not design, of A.C. machinery as presented to senior electrical engineering students in America.]

"Principles of the Telephone." Part I. Subscriber's Apparatus. By C. M. Jansky and D. C. Faber. 9¼ in. by 6 in. 160 pp. 125 figures. (New York: McGraw-Hill Book Co. London: Hill Publishing Co., Ltd.) 6s. 3d. net.

[Another American publication setting forth the principles underlying good construction based on practical experience.]

OVERSEAS TRADE OF THE GENERAL ELECTRIC CO., LTD.

[*Communicated.*]

VARIOUS suggestions have been made for a constructive policy to enable British manufacturers to take the fullest advantage of the overseas trade, which is confidently expected to develop after the war. Many of the proposals involve a drastic reorganisation of pre-war methods as followed by the general run of British industrial concerns. They demand not only co-ordination in manufacture, but a wide extension of the means taken to secure business and to carry out orders in the world's markets. With this subject as focus of discussion, it is

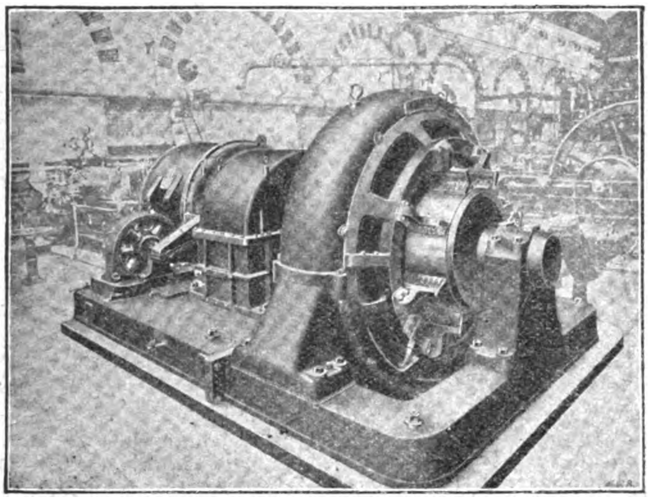


Fig. 1.

interesting to realise that the organisation put into action by the General Electric Co., Ltd., before the war is precisely of the character towards which war-awakened enterprise in other countries is now tending. The war will not bring about any material change in this organisation. All that will be necessary is that the machinery already at work should "carry on" upon the broader basis which trade growth after the war will demand. The dominating feature in electrical overseas trade is the activity of large electrical manufacturing companies which canvass actively for business in even the remotest corners. The pace is set, so to speak, by the American and German electrical combinations, which have enjoyed protected home markets and other advantages not yet granted to British firms. Competition under such conditions has not been an easy matter, but it has not been found impossible. Recognising that it was essential to conduct operations on a scale comparable with that of the chief rivals abroad, the G.E.C. set itself many years ago to build up overseas companies capable of supplying the electrical

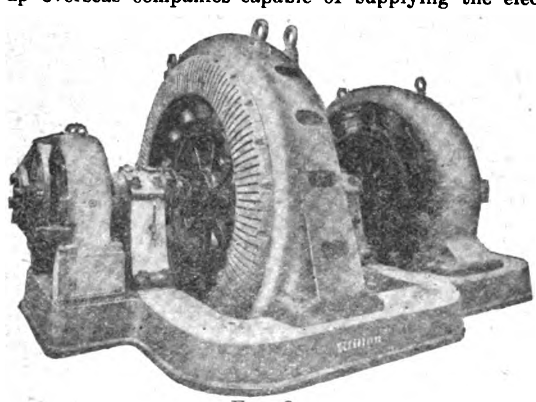


Fig. 2.

demands of all the chief markets. These companies, through their connection with the co-ordinated manufacturing concerns of the G.E.C. in Great Britain, were able to quote for complete electrical installations. They were, moreover, provided with staffs capable of erecting the installations and putting them into operation. This organisation has reached so high a stage of development that the overseas companies have not only laid down complete power plants, but have actually placed stock orders for electric supply equipments, including power houses, switchboards, transformers, distribution cables, lamps, motors, and all accessories. In a word, manufacturing and business-getting facilities have been correlated in a steady and vigorous growth. While the world-wide selling organisation directly benefits the general electrical engineering, the cable, telephone, instrument, carbon, lamp and other factories of the parent Company, it also brings a great deal of grist to British manufacturers allied with the electrical industry. Orders for turbines and other steam-driven engines; for gas, oil, and other internal combustion engines; for producer-gas installations; for boilers, condensers, pumps, economisers, and numerous other accessories are involved in the contracts for complete electric power equipments. Thus the G.E.C. organisation acts as a feeder for the manufacturers of other non-electrical items, and has been the means of bringing orders to British firms from parts of the world where they were not represented.

It may be of interest briefly to give some idea of the G.E.C. overseas organisation and of the kind of plant it supplies.

South Africa is covered by the British General Electric Co., Ltd., whose headquarters are at Johannesburg, with branches at Cape Town, Durban, Bulawayo, and other places. The 1,000-kw. "Witton" generator shown in Fig. 1 is located at the power-house of the Durban Corporation, and is driven through gearing by a Parsons Turbine. This is a typical example of plant sent abroad by the G.E.C. One of the special lines of activity of the South African Company consists of complete town lighting schemes—Ermelo, Pietersberg, and Bethel provide a few examples out of many. Undertaking to supply the whole of a power plant and distribution system, the South African Company is able to deal with schemes in a manner far more satisfactory than if plant and apparatus were ordered piecemeal. Much other important work in South Africa has been undertaken by this Company, including, for instance, a pumping plant for the Rand Water Board.

The British General Electric Co., Ltd., of Australia, is actively engaged in the electrical trade of the Australian Commonwealth. Its headquarters are in Sydney; its branches are at Brisbane, Melbourne, Wellington (N.Z.), and other places. As a typical instance of "Witton" plant supplied to Australia, it may be mentioned that two 275-k.v.a. alternators have been supplied to Adelaide Cement Works. These sets are driven

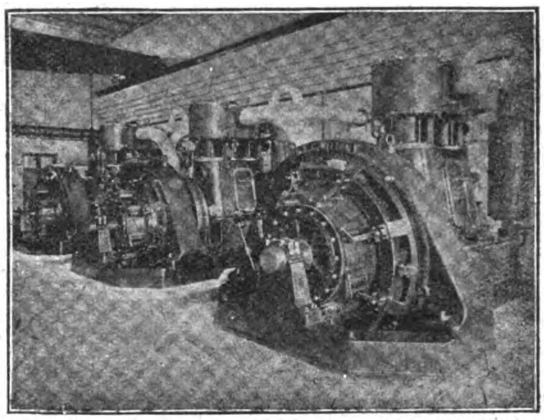


Fig. 3.

by Premier gas-engines, and are interesting as the only gas-driven alternators to run in parallel in Australia, and their operation has been entirely satisfactory. Important work has been undertaken for the municipalities in Australia. Some idea of this type of order is conveyed by Fig. 2, which illustrates a motor generator supplied to the Melbourne Corporation. For this set a repeat order was given after many years of working. In addition, considerable work has been done in the smaller towns.

India is covered by the General Electric Co. (India), Ltd., with headquarters at Calcutta and a branch at Madras. This Company has secured many important Government contracts, of which a characteristic example is the plant shown in Fig. 3. Most electric motors make money for their users, but those here depicted make it rather more quickly perhaps than do some others. They are installed in the Calcutta Mint, the generating plant of which comprises three 270-kw. "Witton" C.C. generators driven by Belliss engines; there is, in addition, a complete installation of "Witton" motors.

One of the most important of the G.E.C. Overseas Companies is the General Electric Co. of China, Ltd., which is engaged in the heavy competition for the Chinese electrical trade. Headquarters are at Shanghai, with branches at Hong Kong and Hankow. A considerable number of complete electrical equipments for Chinese towns—for instance, Fatshan, Soochow, Ningpo, and Yangchow—have been undertaken by this Company.

In South America the Argentine is covered by the Anglo-Argentino General Electric Co., Ltd., of Buenos Aires and Chili, and other territories by Messrs. Huth & Co., of Valparaiso and other towns. Amongst the important plants installed by the G.E.C. may be mentioned the complete equipment of the power-house of the large Chilian Naval Dockyard at Talcahuano, and the installation at the Concepcion Flour Mills; while in Brazil G.E.C. machines are working in the Manaos power-house.

A "Witton" plant installed nearer home will be observed in

Fig. 4. This is a complete rotary converter installation supplied for driving the Barcelona Tramways. France is covered by the General Electric de France, and Belgium by the G.E.C. of Belgium.

The foregoing remarks will give some idea of the overseas activities of the G.E.C. When, after the war, the home works are able to devote themselves to the huge volume of export trade, it is certain that the G.E.C. overseas selling organisation will be able to handle the trade and to divert it into British channels.

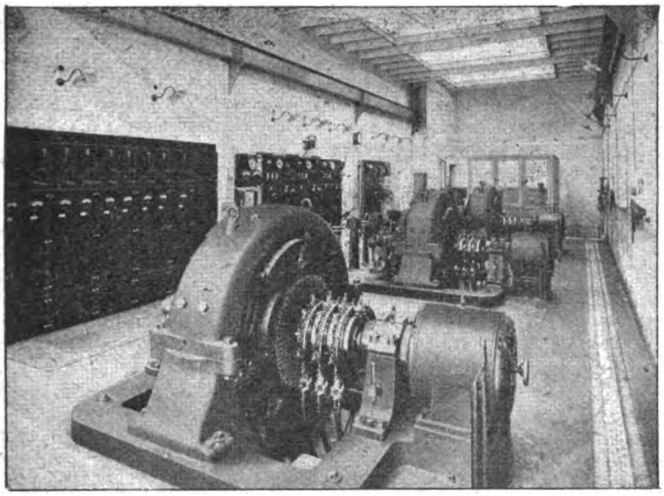
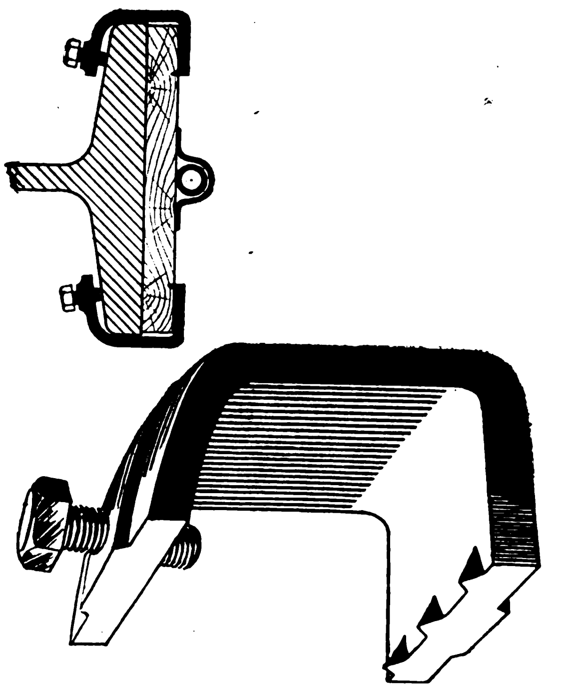


FIG. 4.

"SIMPLEX" UNIVERSAL GIRDER CLAMPS

ONE of the greatest difficulties in present-day wiring installation work is the trouble experienced in negotiating steel girders, and, as all the new buildings are largely using these, a well-designed girder clip is a more important item than it used to be. The large number of sections of girders render it more difficult to clamp conveniently conduits and other fixtures, so that a universal girder clamp is very necessary.

The Engineering Standards Committee have done excellent work by choosing certain girders for general use, but the number is still very great. There are section rolled girders, riveted girders, also channels, angles and tee sections in great variety.



A large number of girder clips are on the market, and nearly all of them are made for a particular section of girder, and even when a certain amount of adjustment is embodied in their design it is only within small limits it can be used. When setting out on the design of a universal girder fixing it is at once evident that to clamp securely a small wooden batten to the metal provides the best arrangement.

It is this special feature that the Simplex Girder Clip covers, as it consists of a pair of clamps which fasten on to the edges of the girder and hold a wood piece on to which a saddle for the conduit, junction box or other accessory, can be fixed by an ordinary wood screw. The clamps are made of tough, malleable iron, in two sizes at present, and are provided with a set-screw for drawing the wood tight up to the under side of the girder, two or three sharp points being arranged to ensure the wood being securely held. The wood batten is not sold with the clip as this can easily be obtained on the job. It is the wood which provides the packing for the clamp, and it can be easily arranged the correct thickness for the particular girder flange in question. For angles or odd sections, the batten can be placed lengthwise and two girder clamps spaced along the free edges to hold it securely in position ready for the conduit erector.

WEATHERPROOF LANTERNS FOR INDUSTRIAL LIGHTING

ALTHOUGH the present time outdoor lighting is conspicuous by its subdued character, this is not due to the absence of suitable lamps or fittings. When the removal of the temporary lighting restrictions becomes advisable, the opportunity will be seized, therefore, to bring up-to-date existing systems of outdoor illumination. Many applications of the half-watt type lamp have been hindered by the need for reduced lighting, but with the return of normal conditions we may expect progress to be rapid. The introduction of a wide range of sizes of these lamps has been accompanied by the evolution of an equally extensive series of lanterns and reflectors for use with them. These fittings have been designed specially to suit the characteristics of high-efficiency lamps, with the result that outdoor illumination may be carried out not only on correct scientific lines, but may be of an agreeable character. In anticipation of the coming demand for improved outdoor lighting schemes, the British Thomson-Houston Co., Ltd. (Mazda House, 77 Upper Thames Street, E.C.), has published a 44 pp. catalogue devoted exclusively to the subject of weatherproof lanterns, street lighting fittings and accessories, ironclad ship and mill fittings, and the like for use with standard and half-watt type lamps. It is by far the most comprehensive list of its kind yet published and it illustrates and gives details of a number of fittings that are quite new in design.

Large numbers of arc lamps and clusters of glow lamps that no longer represent the highest degree of economy are being replaced by half-watt type lamps in conjunction with special reflectors and lanterns, and this process of changing over—checked to some extent by war conditions—will be accelerated when street lighting authorities and industrial users are able freely to take advantage of recent developments. Half-watt type lamps are now available in sizes from 15 to 1.500 watts, and for voltages between 25 and 255. They can be used on alternating-current circuits of any frequency down to 25 cycles, and may be run satisfactorily singly on high or low voltage D.C. or A.C. supplies, or in series to replace groups of arc lamps. Their efficiency compares favourably with any type of arc lamp, while the absence of moving parts, their steady, uniform, and intensely white light, their long life and low maintenance costs, are advantages that no user can afford to neglect. Owing to the high temperature at which the half-watt type lamp operates, it is essential that, when used out of doors, it should be thoroughly protected from the weather, particularly from driving rain, and that adequate provision be made for ventilation, while providing for scientific distribution of the light. These points have received careful attention from the makers, whose lanterns reach the highest standard both as regards the form of light distribution and the efficiency of the reflecting surfaces employed.

Among the new weatherproof models listed are the "Strela" cast-iron lantern with vitreous enamelled reflector; the "Globa," the "Alabas," the "Ilstra" street lighting unit, and the "Radial Wave," all of which are suitable for Mazda half-watts. These provide in every case for adjustment of the total length, so that lamps of different sizes may be employed in the correct position relative to the reflector. The B.T.-H. series incandescent street lighting system provides for the replacement of arc lamps on series circuits without altering the existing circuits, substitutional resistances with automatic cut-out for each lamp, constant current transformers for each circuit, with an automatic film cut-out for each lamp, or an automatic film cut-out for each lamp only, being included to prevent the extinction of a number of neighbouring lamps. Many ornamental designs of British-made cast-iron and ferro-concrete pillars for incandescent street lighting are listed, as well as water-tight lanterns, fittings, and holders for standard Mazda lamps, used in mills, factories, shop windows, and steamships. Copies of this exhaustive catalogue, which gives the fullest information as to constructions, dimensions, applications, and prices of a great number of lanterns and fittings, are at the disposal of readers interested in street and industrial lighting.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published November 16th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

13,586/15. **Transformers.** C. H. THORDARSON. An improved construction of transformer coil windings, arranged so that a cooling medium may be directed uniformly to every part of the windings. One of the windings is spaced from the other to provide longitudinal oil conduits. The H.T. winding is composed of a series of slab units of spirally wound flat wires insulated between the turns, and with the edges of such turn exposed. They are spaced so as to provide between the units radial oil passages communicating with the longitudinal oil conduits.

15,008/15. **Ship Propulsion.** BRITISH THOMSON-HOUSTON CO. (*G.E. Co., U.S.A.*). In a system of electrical ship propulsion comprising a generator adapted to deliver energy to all the propeller motors at a low speed, and some only of the motors at a high speed, changing the armature circuits of the generator so that it operates on a different characteristic curve when delivering energy to all the motors than when delivering energy to some only of the motors.

15,186/15. **Single-phase Motors.** BRITISH THOMSON-HOUSTON CO. (*G.E. Co., U.S.A.*). Single-phase induction motor designed to combine high starting torque with good efficiency on normal load, with two displaced primary windings, one of which is provided with a phase-shifting device, and a secondary winding having high impedance when the slip is large and low impedance when the slip is small.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: T. O. CALLENDER and CALLENDER'S CABLE & CONSTRUCTION CO. [Cables] 2,986/16 (*101,914*).

Electrometallurgy and Electrochemistry: WHEELER [Cathode for electrolytic cells] 15,759/15; DEUTSCHE GOLD & SILBER SCHEIDEANSTALT VORM. ROESSLER [Electrolytic production of sodium] 3,084/15 (*100,152*).

Instruments and Meters: MARCONI'S WIRELESS TELEGRAPH CO. and EWEN [Measuring instruments, relays, &c.] 13,852/15.

Telephony and Telegraphy: SIGNAL GES. [Diaphragm transmitter for submarine sound signals] 14,594/15; BRITISH THOMSON-HOUSTON CO. [Wireless telegraph systems] 15,237/15.

Traction: A. G. BROWN, BOVERI & CO. [Multiple control apparatus for electric railways] 10,099/15 (*101,023*).

Miscellaneous: THOMAS [Firedamp detecting attachment for electric miners' lamps] 15,094/15; GASTER and DOW [Automatic apparatus for extinguishing the light from portable electric lamps in predetermined directions] 15,261/15; WARREN [Electric clocks] 15,370/15; P. M. LINCOLN [Electric indicators] 951/16 (*101,898*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Ignition, &c.: C. F. KETTERING and W. A. CHRYST [Generating system for car auxiliary services] 6,405/16 (*101,960*); H. R. VAN DEVENTER [Ignition mechanism] 13,665/16 (*101,965*); C. T. MASON [Ignition systems] 15,351/16 (*101,980*).

Amendment made

1,995/15. **Telephone Exchanges.** O. IMRAY (*Siemens & Halske, A.-G.*). This specification, which describes improved selector arrangements for automatic telephone exchanges, has been amended by way of disclaimer.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

25,933/02. **Miners' Lamps.** P. WOLF. A simple form of magnetic lock for miners' lamps.

26,395/02. **Wireless Telegraphy.** P. ARTOM. A system of wireless telegraphy transmission, employing circularly or elliptically polarised waves.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: JANDUS ARC LAMP & ELECTRIC CO. and A. D. JONES [Rocking lever mechanism for arc-lamp feed] 16,151/08.

Incandescent Lamps: H. KUZEL [Soldering of metal filaments to leading-in wires] 12,153/06; W. D. COOLIDGE [Mechanical mounting of filaments] 17,360/07; GES. FÜR VERWERTUNG CHEMISCHER PRODUKTE [Ageing metal filaments by heat treatment to secure constancy of radiation] 19,672/07.

Storage Batteries: H. RAMSBOTTOM and J. M. RICHARDSON [Sealing of secondary cells] 16,868/03.

Switchgear, Fuses and Fittings: J. G. STATTER [Suction disc time element device for circuit breakers] 16,846/04.

Miscellaneous: W. H. MUZZY [Electrically indicating cash registers] 15,200/05; R. B. NORTH and C. H. KIRBY [Electric control of sirens] 17,619/09.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

The Principles of Electrical Engineering and their Application. By G. Kapp. Vol. I. Principles. 356 pp. 9 in. by 5¾ in. 175 figures. (London: Edward Arnold.) 15s. net; abroad 15s. 10d.

A TEXT-BOOK by so experienced a technical writer as Professor Kapp, who holds a high position in the teaching of electrical engineering in this country, carries with it a guarantee of soundness of treatment and clearness of exposition, and needs no apology for adding itself to the many others clamouring for positions on the shelves of the engineering student, and rather than discussing the sequence of its contents in detail it is more useful to indicate the exact class of reader to which it is addressed. The work is not one for the elementary student, nor indeed does it primarily seek out the man proposing to specialise in electrical engineering, but is addressed more to the "general" engineer to give him a broad understanding of a subject with which he is bound to come at nearly every turn in his profession. The electrical engineer himself is amply provided with literature from his student to his specialist days, but the author sees a want to be filled in the requirements of the man requiring more general knowledge. We do not wish to convey that the work is in any way superficial, in spite of the wide field it covers. Mathematics enters freely into the treatment, and the work is kept within bounds by the elimination of the redundant rather than the skimming over the surface of the subject. After the present volume dealing with principles of direct and alternating currents, magnetism, electrostatics, etc., we look forward to another discussing their applications.

Alternating Currents in Theory and Practice. By W. H. N. James. 353 pp. 9 in. by 5¾ in. 236 figures. (Cambridge: The University Press.) 10s. 6d. net; abroad 11s.

THE author, who is a lecturer in electrical engineering at a provincial technical college, in adding to the growing list of books dealing with the principles of alternating currents, has addressed himself mainly to those whose knowledge of mathematics is comparatively small and, while giving a pretty full account of the laws governing the flow of the alternating currents, includes also a good deal of practical detail in the design and construction of A.C. machines and apparatus. The treatment is clear, the diagrams and illustrations are excellent, and the practical notes up to date, and without the least suspicion of the fault, common in some text-books, of reading like cuttings from manufacturers' catalogues. For a certain class of students desiring to specialise afterwards in particular branches of A.C. work, the book should be found distinctly useful.

LOCAL NOTES

Bradford: *Accident at Electricity Works.*—As the result of the collapse of some staging upon which workmen were engaged on the steel chimney stack at the electricity works, one man was killed and two injured, one of them seriously. The men fell from a height of about sixty feet.

Finchley: *The Minimum Charge.*—A deputation of ratepayers which has waited upon the Council to protest against the minimum charge of 10 units during the summer quarter and 20 units during the winter seems to have been satisfied with the equity of the position after having had it explained to them in detail. The Council is entitled to make a minimum charge of 20 units winter and summer, and the deputation, in the words of the Chairman of the Electricity Committee, went away "satisfied that the Electricity Committee were not out to take any unfair advantage of any particular section of the consumers, but were acting in the general interests of the undertaking and the consumers."

Greenock: *Electricity Accounts.*—The net surplus on the working of the electricity undertaking for the year to June 30 was £6,998, against £9,447 in the previous twelve months, after allowing £4,668 for depreciation, in addition to the usual capital charges. The output was 23¼ million units, compared with 16,881,777 units in the previous twelve months. Of this increase, 25 per cent. has been obtained from Greenock consumers and 7 per cent. from increased supplies to Port Glasgow users. The total cost per unit sold, exclusive of public lighting, was 0.659d., against 0.52d., but of this increase of 0.139d. per unit, the extra price of coal is responsible for 0.1d. In addition, wages, repairs, maintenance and distribution have all increased considerably over the 1914-15 figures. New economisers, consisting of 1,408 tubes, were installed during the year and the new 5,000 kilowatt Westinghouse turbo-generator was started up early in 1916. Arrangements have been made for the installation of two 30,000 lbs. per hour B. and W. boilers, with chain grate stokers, superheaters, economisers, induced draught fans and steel chimney, forming one complete steam generating unit. The publicity work of the Department has practically been suspended on account of the war. Work of national importance only has been accepted, although incidentally, a large business was done in electric radiators, kettles, iron, etc. Altogether 284 motors, radiators, and other appliances, representing 468 k.w. were sent out during the year from the Department Show Rooms.

Middlesbrough: *Linking-up.*—At the last meeting of the Corporation the question of linking-up was mentioned. The Chairman of the Electricity Committee, however, remarked that the national scheme is "in the air," and that the Corporation was in the happy position of already reaping the advantages of such a scheme in the arrangements it had with power companies for bulk supply.

Newport, Mon.: *Electricity Deficit.*—There was a deficit of £993 on the working of the electricity undertaking last year, due mainly to the restriction of public and private lighting. The loss from this, however, was to some extent counterbalanced by the extra supplies for power purposes. The major portion of the final deficit, however, is accounted for by the fact that the Local Government Board decided that a sum of £578 should be charged to revenue and not capital.

Ripon: *Provisional Order.*—At a special meeting of the Council recently the question of applying to the Board of Trade for an Electric Lighting Provisional Order was discussed and eventually deferred until the next meeting.

Wolverhampton: *Industrial Development.*—In their annual report the Electricity Committee referred to the fact that negotiations have taken place with several important industrial undertakings who have under consideration the question of building new works with a view to their taking electricity supply.

APPOINTMENTS AND PERSONAL NOTES

The Hughes Medal of the Royal Society has been presented to Professor Elihu Thomson for his researches in experimental electricity.

The Wigan Electricity Committee has offered the vacant post of Borough electrical engineer to Mr. R. Owen, deputy city electrical engineer at Leeds. The salary is £550 per annum, with house, lighting, and fuel, or alternatively £600 without house, &c. There were 106 applicants for the post.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Accrington.—The General Purposes Committee has decided to purchase an electrically-driven motor wagon at a cost of £1,100.

Hull.—The Council has decided to apply to the Local Government Board for sanction to proceed with the scheme for providing a water-cooling system at the electricity works. This was deleted from a scheme put forward in February, 1915, at the request of the Treasury, but the development of the undertaking since has rendered these works necessary.

St.Annes-on-the-Sea.—Among the after-war works contemplated by the Council are extensions to the electricity undertaking.

Miscellaneous

Durham.—A six-months' supply of electrical fittings is required for the Trimdon Grange Colliery, County Durham. December 3.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £161 to £163 (last week £149 to £152).

Agencies.—The Commercial Intelligence Branch of the Board of Trade have the name and address of an Australian firm anxious to represent United Kingdom manufacturers either in New South Wales or the whole of the Commonwealth for electrical accessories, such as fuses, cut-outs, switches, ceiling roses, adaptors, lamp holders, etc.

A Sydney firm desires to represent United Kingdom manufacturers of arc lamps and accessories.

The Board of Trade Intelligence Department has enquiries for the names of British manufacturers of storage batteries, electric fans, transformers, etc., who wish to be represented in Melbourne.

Further particulars at 73, Basinghall Street, E.C.

Change of Address.—In consequence of the Government requiring the whole of India House and the two adjoining buildings for purposes connected with the war, Messrs. Wellman, Seaver and Head, Ltd., are obliged to vacate these offices temporarily and to move to new premises. On and after November 21 (and until further notice), the firm's address will be King's House, Kingsway, W.C. The telegraphic address and telephone number will remain the same, viz., "Principium, Estrand, London," and "Holborn 1782."

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Electric Construction Company.—An interim dividend at the rate of 7 per cent. per annum is recommended on the preference shares for the September half-year, less tax.

Companies Struck Off Register.—The names of the Electric Ozone Syndicate and the Wireless Electric Light Co. have been struck off the register of joint stock companies.

The names of the following will be struck off the register of Joint Stock Companies in three months unless cause is shown to the contrary: Bridlington Electrical Engineering Co., United Electric Light & Power Supply Co.

NEW COMPANIES

FELLOWS MAGNETO CO.—Capital £75,000, 99-103 Horseferry Road, Westminster. To carry on business as indicated by the title. The Treasury raises no objection to the issue of capital.

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SUMMARY

THE engineering problems connected with the parallel running of large linked-up power stations were dealt with in a Paper by Mr. J. S. Peck, which led to an interesting discussion at last Thursday's meeting of the Institution of Electrical Engineers (pp. 448-450).

IN his chairman's address to the Scottish Local Section recently Mr. J. K. Stothert gave a general review of the industrial position (p. 450).

THE official designation of the Electric Vehicle Committee in future will be "The Electric Vehicle Committee of Great Britain, formed under the auspices of the Incorporated Municipal Electrical Association." The Ministry of Munitions has been communicated with as to permission being granted to British electric vehicle manufacturers to continue to manufacture electric vehicles for commercial purposes (p. 450).

A PROBLEM connected with the resistances of branched circuits and the currents therein is worked out in our Questions and Answers columns (p. 451).

WE reproduce an article issued by the American Department of Commerce giving advice to American electrical manufacturers in regard to foreign trade. It is a good example of the manner in which a Ministry of Commerce in this country could help British manufacturers (p. 452).

AMONG the subjects of specifications published at the Patent Office last Thursday were dirigible torpedoes, wireless telegraphy, and hand-lamps. The grant of a patent for high-frequency apparatus has been refused on account of opposition. Patents connected with wireless telegraphy and meters expire this week after a full life of 14 years (p. 454).

DISCUSSING the effect of the European War upon American industries recently, Mr. C. P. Steinmetz said the most profound change must be looked for in international trade, and America must awaken to the necessity for developing all its industries to the highest state of efficiency and maximum economy (p. 455).

THE Hammersmith Borough Council proposes to take over, temporarily, at any rate, part of the Fulham Council's load.—Difficulties still continue with the tramway supply at Birmingham, but the work of repairs and the installation of additional plant is being rapidly pushed ahead (p. 455).

A LOAN of £5,000 has been sanctioned for new plant at Dundee. Auto-transformers are required at Hammersmith (p. 456).

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE, S.W.
ORDERS FOR THE WEEK BY LT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the week.—Platoon Commander H. de P. Birkett.
Next for duty.—Platoon Commander Parker.

Monday, Dec. 4th.—Technical for Platoon No. 9 at Regency Street. Squad and Platoon drill, Platoon No. 10. Signalling class. Recruits drill, 6.25—8. Lecture on Telephones, 7.30.

Tuesday, Dec. 5th.—School of Arms, 6—7. Lecture, 7.15, "The Service of Protection," Coy. Cmdr. Hynam.

Wednesday, Dec. 6th.—Instructional class, 6.15. Platoon drill, Platoon No. 2.

Thursday, Dec. 7th.—Platoon drill, Platoon 7. Ambulance class by M.O., 6.

Friday, Dec. 8th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon drill No. 9. Signalling class. Recruits drill, 6.25—8.25. Lecture on Telephones, 7.30.

Saturday, Dec. 9th.—Inspection by General Sir Desmond O'Callaghan at 3 in Hyde Park. Parade in uniform at Headquarters at 2.15 sharp. A full muster is of great importance.

Sunday, Dec. 10th.—Entrenching at Otford. Parade Victoria (S.E. & C. Ry. booking office), 8.45 a.m. Uniform, haversacks, water-bottles. Midday ration to be carried. Railway vouchers will be provided.

Musketry.—For all Companies, see Notice at Headquarters.

Unless otherwise indicated all drills, etc., will take place at Headquarters.

Corps Supper.—A Corps Supper will be held at the Queen's Hotel, Leicester Square, on Dec. 8th, at 7. A few tickets can still be had of the Company Sergeant-Major.

Arrangements for the Week.—To-day (*Thursday*), *Nov. 30th.*—Greenock Electrical Society, 22 West Stewart Street. "What is Electricity," by J. L. Hogg. 7.45 p.m.

Monday, Dec. 4th.—Institution of Post Office Electrical Engineers at Institution of Electrical Engineers. "The Western Electric Co.'s Auto-telephone System," by B. A. Anson. 6 p.m.

Tuesday, Dec. 5th.—Manchester Engineers' Club, Albert Square. Debate on the Decimal System. 7.30 p.m.

Wednesday, Dec. 6th.—Institution of Electrical Engineers. Birmingham Section. At the University. "The Parallel Operation of Electric Power Stations," by J. S. Peck. 7 p.m.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

The Loose Leaf Laboratory Manual: Electrical Measurements and Testing: Direct and Alternating Current. By C. L. Davies. 44 leaves. 10½ in. by 8 in. 52 figures. (New York: John Wiley & Sons. London: Chapman & Hall, Ltd.) 3s. net, by post 3s. 3d.

THIS is a collection of about 40 sheets, each describing an experiment or laboratory test and setting forth briefly the object of the operations, the apparatus required, the connection to be made, the procedure in conducting the experiment, and the form in which the report is to be drawn up. The author is instructor in electrical engineering at Harvard University, and the manual is designed to accompany Trinitie's "Electrical Measurements in Direct and Alternating Current," and Karapetoff's "Elementary Electrical Testing," both well-known works on the other side of the Atlantic. Most of the sheets, however, could be adapted for use in any well-equipped laboratory provided with D.C. and A.C. machinery, although a few of the experiments refer to machines and conditions not usually met with in this country.

Joseph Pennell's Pictures of the Wonder of Work. 10¼ by 7½ in. 52 plates. (London: William Heinemann.) 7s. 6d. net; abroad, 8s. 6d.

In this charming volume we have reproductions of the work of an admirable and versatile artist, dealing with the industrial subjects. He teaches us how to find beauty in much that is commonly dismissed by the artist as ugly, and the drawings, etchings, lithographs, &c., which he gives us derive a fine inspiration from the grandeur of industrial achievement. His own notes and his thoughtful introduction accompany the sketches, and the subjects come from all parts of the world. For its balance of black and white we like the first as well as any, rebuilding the public buildings in Philadelphia; for grandeur of conception, his night scenes in Belgian ironworks; and for delicacy of suggestion, his rebuilding the bridge at Cologne.

PARALLEL RUNNING OF ELECTRIC POWER STATIONS

The various engineering problems connected with the linking-up of large power-stations, a subject of particular importance, in view of the many schemes of this nature likely to be carried out in the near future, were considered in a paper by Mr. J. S. Peck, discussed at the meeting of the Institution of Electrical Engineers last Thursday.—The author remarked that fortunately the great majority of stations in this country generate three-phase current of 50 periods, so that the problem of inter-connecting is relatively simple. But there are a number of large systems which generate at 25 and 40 periods, several generate at 60 periods, two large stations generate at 33 periods, while a considerable number generate at other frequencies. These last are principally single-phase systems. The problem of linking-up systems of different frequencies is much more complicated than that of linking-up systems of the same frequency.

When two alternating-current generators having the same number of poles and the same rating are operated in parallel, they must, of course, run at exactly the same speed, and, if they are to divide the load equally, it is essential that the two engines (or turbines) driving them should have the same speed regulation. The load carried by the generator is determined by the amount of steam admitted to the engine, and not by the adjustment of the field strength of either machine. Two machines may be made to divide the load in any desired proportion by proper adjustment of the steam supply, while adjustments of the field rheostats simply cause wattless currents to flow between the generators. The operation of two or more stations in parallel is simply the operation of two or more groups of generators in parallel, except for the fact that the inter-connecting line possesses inductance and resistance.

When the stations to be linked-up have the same frequency, voltage, and phase, the only inter-connecting link required is a cable with the necessary switches, etc., for connecting together the busbars of the two stations. It frequently happens, however, that the voltages of the two stations are not exactly equal, and it may be required to vary the voltage of either station independently of that of the other. For this reason it is desirable to have some form of voltage regulator in at least one of the stations, otherwise, when voltage adjustments are attempted, heavy wattless currents will flow between the stations and the voltages on the two systems will remain equal, except for the difference due to the drop of pressure in the cable. The regulater may be of the step by step or the induction type.

If the stations have equal capacities they must run in synchronism and deliver at all times equal loads. Therefore, if the load on one set of busbars is greater than that on the other, half this difference will be supplied by each station, and the connecting feeder must carry half the differnce in load.

The case where the stations are of unequal capacity, but the same speed regulation is similar, except that instead of the total load being divided equally it will be divided in proportion to the capacities of the stations. If the loads are steady the engine governors may be adjusted by hand to give the minimum or any other desired load on the inter-connector, where violent fluctuations occur manual adjustments of the governor are impossible, and account must be taken of this fact when designing the inter-connecting line.

Where the engine governors of two systems are set for different speed regulations, they will divide the total load not in proportion to their generating capacities, but in direct proportion to their ratings and in inverse proportion to their speed regulation, assuming a straight-line speed drop. As in operating machines in parallel, when the regulation cannot be made equal on two machines, the larger one should have the closer regulation. Although the speed curve may not be exactly a straight line, the distribution of load can be calculated sufficiently close for all practical purposes. In the actual parallel operation of alternators in a station, the loads are seldom divided exactly in proportion to the ratings of the different machines, but shift from one set to another with variations in the external load, depending on the governor adjustments. This causes, however, no trouble in the station as long as the sets share their loads properly at the full output of the station, and hand adjustment of the governors is necessary from time to time. It is becoming standard practice in all large generating stations to earth the neutral point of the system. Where the busbars of two earthed systems are directly coupled together there may be heavy high-frequency currents flowing through earth between the stations, and these currents may cause trouble in telephone and telegraph circuits. There are several ways of overcoming this difficulty:—(a) One station only may be earthed. In this case arrangements could be made so that when the inter-connector is opened the unearthed system would be earthed. (b) An insulated earth cable could be run from one system to the earth on the other system, *i.e.*, both systems would have a common earthed point. (c) Transformers could be inserted in the inter-connecting line. (d) Reactances or resistances could be placed in the earth connection to limit the earth currents to a negligible value.

Where the stations are of the same frequency but of different phase or voltage, it is necessary to introduce transformers into the inter-connector. The voltage and phase transformation is made, where such is required, in the same transformers. Apart from the introduction of transformers, the operating conditions for stations having different voltages or phases are exactly the same as when the stations have the same voltage and phase, except where it is required to link-up a single-phase system with a two or three phase system. If it is desired to distribute the load equally on all phases of the three-phase or two-phase system, rotating apparatus is required. This may take the form of a motor-generator or a phase converter. When two stations of different frequencies are to be linked-up it is necessary to use a frequency changer of the rotating type. This will usually take the form of a motor-generator, but in certain cases where continuous current is required it may be advantageous to use a rotary converter for changing from one frequency to continuous current, and another to change from continuous current to the other frequency. Under this condition it is, of course, possible to use both rotary converters for supplying continuous-current load from the two different systems. The cost of a motor-generator is comparatively high, and while it is desirable to keep down its size to correspond to the load which it is desired to transmit from one station to the other, its capacity must also be chosen with reference to the load it may have to transmit under abnormal conditions, and the choice of the type of converting plant will be governed largely by this consideration.

The motor-generator for frequency transformation may be either of the following types:—Synchronous motor and synchronous generator—called "synchronous motor-generator." Induction motor and synchronous generator—called "induction motor-generator." Each set has the following advantages and disadvantages:—

Advantages of Synchronous Set.—It is reversible and can supply energy in either direction without change from the normal speed ratio. The motoring machine can be run at unity power factor, or even with a leading power factor, and thus assist in improving the power factor of the system. The generating machine may be run with an over-excited field and so reduce the lagging current carried by other generators on the system.

Disadvantages.—The set, acting as a rigid coupling, forces the two systems to run at a fixed speed ratio and is therefore subject to heavy overloads under certain conditions. Each machine must be synchronised with its own system, an operation requiring some skill, especially with certain ratios between the numbers of poles.

Where two motor-generators are operated in parallel special arrangements are required in order to synchronise an unloaded set with one under load.

Advantages of Induction Motor-generator.—It is a flexible link and permits a small set to be used between two large systems. It is easier to start and put into operation. By using an adjustable secondary resistance, it is possible manually to control over a considerable range the amount of energy transmitted by the set, though this involves a certain loss in efficiency.

Disadvantages.—A comparatively large difference in speed between the two systems is required in order that it may transfer its rated output from one to the other. This large difference in speed often limits the induction set to transmitting in one direction only. The induction machine requires a considerable lagging current, and no power-factor control is possible on this machine without introducing some form of phase advancer.

The great advantages which the synchronous set possesses, of permitting power-factor control and of transmitting energy in either direction without change in speed ratio between the two systems, make it desirable to use the synchronous set in preference to the induction set whenever possible.

Under certain circumstances it might be desirable to inter-connect two systems of different frequency by means of rotary converters. In general, this is only commercially feasible where continuous current is required in at least one of the stations. In many large continuous-current stations extensions are made at present with turbo plant. Where the units are of considerable size it is customary to use a high-speed turbine and to gear it to a moderate-speed continuous-current generator, or else to use a high-speed turbo-alternator and to convert to continuous current through a rotary converter. The

latter arrangement offers a ready means of linking-up with an alternating-current station should it ever be desired to do so.

It is common practice to operate electro-hydraulic systems of the same frequency in parallel, and on the Continent and in America many large transmission net-works are supplied from stations located long distances apart. In Great Britain an increasing number of systems of the same frequency are being operated in parallel, but there has been very little done towards linking-up sytems of different frequencies.

The author concludes with the following summary of his conclusions :—

(1) Polyphase systems of the same frequency may be connected together directly or through transformers, and operated in parallel without difficulty, but where each station supplies its own customers it is desirable to have some form of voltage regulator to permit independent control of the voltage of each station. If the stations are located in the neighbourhood of telephone or telegraph circuits, are connected solidly, and have earthed neutrals, provision must be made to prevent high-frequency currents flowing through earth between the stations.

(2) To interconnect a polyphase and a single-phase system of the same frequency a rotating machine of the phase-converter type or a motor-generator is required if the polyphase system is to be symmetrically loaded.

(3) Systems of different frequencies may be interconnected through frequency changers, sets consisting of two synchronous machines or of one synchronous and one induction machine. The synchronous set is usually the more desirable since it permits power-factor control and transmits energy in either direction without a change in the speed ratio between the two systems. It is, however, somewhat more difficult to operate, and to prevent danger from overloading it should have a fairly large capacity with reference to the smaller of the two stations which it interconnects. The induction set is much more flexible, and a small set can be used between two large systems, but it requires a considerable difference in speed ratio between the two systems for transmitting full load, and the induction machine takes wattless current from the system to which it is connected.

(4) In certain cases where continuous current is required the rotary converter may be used with advantage as an interconnector between two stations of different frequencies, or between an alternating and a continuous-current system.

Discussion.

The discussion was opened by Mr. W. B. Woodhouse, Chief Engineer and Manager to the Yorkshire Electric Power Co., who frankly confessed himself sceptical of the possibilities of linking-up existing power stations except at an expense which might not be justified. Mr. Peck had assumed that the problem of linking-up different power stations was the same as running generators in parallel in the same station, but it was very different from that. He put on one side the interconnection of two stations of different frequencies as he foresaw the period when there would be a standard frequency, and stations not working to that standard frequency would have to change over. The real problem was to interconnect two stations of the same frequency, and taking Mr. Peck's first example in the paper, of two systems, each with a normal load of 10,000 kw., with provision for interchanging 5,000 kw., and assuming each was dealing with its own local load, that the consumers' and station voltages were the same in both cases and that the power factor of the two loads was the same, if it were desired to transmit 5,000 kw. from one station to the other with a power factor of 0.75 lagging and a pressure drop of 10 per cent., the situation would be appalling. In order to avoid a 10 per cent. drop in the voltage at the receiving station, steps must be taken to raise the voltage of the sending station. If there was impedance in the line the receiving station must transmit to the sending station a very large amount of idle current, and he had calculated that in order to enable the receiving station to deal with 5,000 kw. of power it would have to have turbine capacity of 5,000 kw. and alternator capacity of very nearly 14,000 k.v.a., in order to provide for the idle current and pressure drop. In order to get over these difficulties it would be necessary to reduce the percentage voltage drop in the transmission line, which could be done either by putting more copper in the line or increasing the transmission voltage. Both methods involved considerable expense, and he was afraid that many people who were considering the linking-up of existing stations would, unless they were very careful, waste a lot of money, because in the majority of cases the voltage at which interconnection would take place was too low for efficiency. Regulating transformers or synchronous boosters could be used. There were disadvantages with the former, and although the 10 per cent. drop already mentioned in the case of 5,000 kw. interchange could be advoided with synchronous boosters, the power would be transmitted at a very low power factor. The most likely method was the use of the synchronous condenser, which dealt not only with pressure variation, but with power factor variation, although, here again, the capital expenditure necessary would be very important. To interchange 5,000 kw. it would be necessary to have a 3,500 k.v.a. synchronous condenser at both stations or to compromise with one machine in the centre of the line. At the same time the advantages were considerable because it would enable reduction of the k.v.a. rating of generators and so help to solve the problem of the constantly decreasing power factor now being experienced on large systems. It was cheaper to put the additional alternator capacity into synchronous condensers, to work the alternator at practically unity power factor and let the synchronous condenser deal with the idle current. The close connection between power factor and pressure drop in the transmission line was not sufficiently realised; the relationship between the two was practically a straight line. Two of the Yorkshire Electric Power Co.'s stations, roughly, 14 miles apart, were connected by overhead lines and provided with automatic regulators, which looked after the stations quite satisfactorily. This, however, would not be the case if it were contemplated to run a number of stations together each being controlled by an independent authority, as difficulties would arise in deciding which station should take the extra load at any particular moment. Hence, it was necessary to devise a system which would regulate itself, otherwise joint working could not be carried out. This he had arranged fairly simply by automatic pressure regulators at each station; the smaller station of the Yorkshire Company running on the pressure gauge of the boiler and not on the ammeter, and that he believed would be the method which must be adopted in the future.

Mr. G. W. Partridge (Chief Engineer to the London Electric Supply Corporation) said good parallel running depended very much on the prime mover, and a difficulty here was as to what would be the prime mover of the future. He agreed that higher pressures must be adopted, and spoke of an underground system which was running at 60,000 volts, although, at the same time, the design of the cable might possibly depend upon the periodicity adopted. He advocated a low periodicity as many advantages accrued from it, The induction motor generator was preferable to the synchronous motor generator as a frequency changer on large systems, as it was less liable to damage or to fall out of step, and he instanced a case in which he is using a 1,500 kw. machine of this type to interconnect a 3-phase 25-period 7,000-volt system to a single-phase 85-period 10,000-volt system. This has been running satisfactorily for over six years.

Mr. A. M. Taylor also did not think sufficient importance had been given in the paper to the problem of connecting two systems of the same frequency and the same voltage. He also referred to experimental work that he has carried out with static frequency changers, stepping up from 25 to 75-cycles, and conversely stepping down. He was prepared to design a 300 kw. frequency changer to step up from 25 to 75-cycles, and regarded it as a practical proposition to group several of them together, making a 3,000 kw. synchroniser.

Sir Charles Parsons asked for further information with regard to what had been done in the matter of linking-up in America. He referred to the tendency of opinion at the present time to district the country, but the difficulty was to decide how to deal with the varying frequencies and pressures and how to avoid undue scrapping of existing plant. As to the prime mover of the future, the possibilities were all in favour of steam holding its own for a long time to come.

Mr. H. Brazil expressed his preference for synchronous motor generators for transferring energy from one system to another mainly on account of its capability for transmitting both ways. Although the induction motor generator would do this it was necessary to bear in mind that it would only transmit energy back when there was plant running on the system to which it was transmitting. In case of it being necessary to take over the whole load of a station that was an important consideration.

Mr. A. P. Trotter spoke on the question of earthing the neutral, and suggested that if one of the two interconnected stations was earthed that should be sufficient to open the circuit breaker if it were overloaded. Although he did not think it necessary to have an insulated cable between two such interconnected stations, if such a cable were used the armouring would do perfectly well for the purpose, as owing to the necessity of reducing earth currents to the lowest possible value in order to avoid trouble with the Post Office the magnitude of the current would be very small.

Mr. W. M. Mordey referred to his paper some year ago, in which he gave figures of tests on static condensers, and expressed his disappointment that this type of apparatus had

not been put upon the market for the purpose of power factor correction.

Mr. E. T. WILLIAMS held the view expressed by Mr. Woodhouse, namely, that interconnection of existing stations is a far bigger problem than appears on the surface. He would prefer to adopt a standard frequency in the various districts into which the country has already been divided and considered that the time had now come to decide upon such standard frequencies. This would assist the engineers in these districts in their plans for extensions at their stations. There should be trunk main systems in the various districts into which all the stations would feed, and, in addition, there should be a trunk system of mains for interconnecting the various districts, and the sooner we got to work on these lines the better.

Mr. PECK, replying, briefly thought that Mr. Woodhouse had unnecessarily piled up difficulties. He agreed that difficulties would arise, but believed they would be overcome much more easily than some of the speakers did. The difficulty, of course, was of necessity to link up stations, each one of which must maintain its own pressure on its own mains. As to the voltage used on the interconnector cable, 6,000 volts would greatly improve present conditions, and he did not think it was desirable yet to go higher than that. The question of low frequency *v.* high frequency mentioned by Mr. Partridge involved difficulties with the turbine builders, who required very much higher speeds than the 1,500 r.p.m., which was the standard speed that could be obtained with a 25 frequency. Want of success had deterred manufacturers from further experiments with static condensers mentioned by Mr. Mordey, and he suggested it as a good subject for one of the Research Committees.

THE ELECTRIC VEHICLE COMMITTEE

A MEETING of the Electric Vehicle Committee was held in London on November 10th, 1916, Mr. E. S. Shrapnell-Smith, the vice-chairman, presiding in the absence of Mr. R. A. Chattock.

Mr. J. A. Priestley, having been elected by the Institute of Cleansing Superintendents as their representative upon the Committee, took his seat for the first time.

Mr. Arthur Harrison, the Borough Engineer of Southwark, attended the meeting by invitation in order to discuss with the members matters concerning the utilisation of electric vehicles for municipal purposes. In the course of an interesting discussion, Mr. Harrison explained the reasons why he had reported recently against the use of electric vehicles for certain work for which he proposed using motor traction. He made it perfectly clear that he was not unfavourable to the principle of the electric vehicle, and that the reason why he had reported against it was really owing to there being no design of electric vehicle on the market which complied with an essential requirement for the particular work, viz., that the loading rail of the body should not be higher than 4 ft. 6 in. above road level. As far as Mr. Harrison was aware, there was no design of electric vehicle at the present time on the market which complied with this requirement. Mr. Harrison expressed the hope that designers would, in the near future, be able to produce a vehicle specially adapted for the particular purpose he has in view, *i.e.*, the quick and easy removal of street sweepings from the depôts or stands in the streets where they are collected, and the collection of house refuse. Mr. Harrison received a hearty vote of thanks for his kindness in attending.

In connection with the provision of charging facilities on the route London to Birmingham, correspondence was read from the Electric Supply Department of the City of Coventry, setting forth that they were unable to give any facilities for charging, and from the manager of the Northampton Electric Light and Power Co., promising to accord every possible facility for charging vehicles and stating that when the amount of business warrants it they will consider putting down a proper charging plant. They have decided to adopt the E.V.C. Standard Tariff.

The Secretary reported that enquiry sheets as to charging facilities had been sent round to electric supply undertakings in connection with the list to be published shortly in the Commercial Motor Users' Association Handbook.

With reference to the Government prohibition of the manufacture of motor vehicles for other than Government use, the Secretary was instructed to lay before the Ministry of Munitions the views of the Committee as to permission being granted to British electric vehicle manufacturers to continue manufacturing electric vehicles for commercial purposes.

It was decided to invite the Institute of Automobile Engineers and the British Rubber Tyre Manufacturers' Association to nominate a representative upon the committee.

It was also decided that the official designation of the committee in future should be:— "The Electric Vehicle Committee of Great Britain, formed under the auspices of the Incorporated Municipal Electrical Association."

A communication was received from the Anderson Electric Car Co., of Detroit, stating that they were arranging to fit the E.V.C. standard plug to all electric vehicles exported to Great Britain and France.

It was decided to recommend to the Accumulator Section of the B.E.A.M.A. that, in the case of lead plate batteries on electric vehicles the upper and lower limits of Sp.G. should be clearly marked on the battery. It is suggested that this should be either in the form of a large plate with raised letters and figures attached to the batter box, or, as an alternative, that the figures should be moulded on the ebonite covers of the cells.

THE INSTITUTION, SCOTTISH SECTION

Chairman's Address

MR. J. K. Stothert delivered his address as chairman of the Glasgow Local Section on November 14th, and dealt mainly with the after-war problems that will present themselves to us, and call for greater and improved efforts on the part of employer and employed and the services of the electrical engineer to at least, if not a greater extent, than of engineers specialising in any other department of engineering. He urged that the question of trade protection should not be made a political football for the purpose of catching votes, but should be treated in all seriousness free from political bias. On the question of technical education and apprenticeship, he deplored the pre-war restrictions of trade unions as to the number of apprentices in proportion to the number of journeymen employed, and expressed the view that trade unions themselves will now see, with so many casualties in their ranks to fill up, that the restriction of the numbers of apprentices would be a fatal policy. On the other hand, employers must see that a little more care and training is given to their apprentices in order to make them skilled workmen more quickly, a result which can only make the employer's business more remunerative and benefit the particular trade. In other words, efforts must be made to make a producer for the nation in the shortest possible time. In one works in the Scottish district salaried men are employed, responsible only to the works manager, whose sole duty it is to teach the apprentices, and this had been found to be mutually beneficial. A part of this scheme was to select the better educated and sharper boys and give them a technical education as part of their apprenticeship system. It is admitted, however, that this latter has not up to the present been so successful as was anticipated due to want of receptivity and sympathy on the part of the lads, and other causes. It is possible, added Mr. Stothert, that technical training throughout the country, including in it the apprenticeship system, will have to be taken in charge by a central authority. Many people held the view that this must be done by the Government, and that the Government must act quickly. The Government, however, would not act quickly unless those interested gave the lead. The question of technical education generally was discussed, and the well-known difficulties of teaching boys working in the shops during the day were recapitulated. Mr. Stothert's view is that they could only be overcome by co-operation between the masters and the men.

Consideration was next given to the question of research, both experimental and industrial, and the work that has been done in this direction since the war under the guidance of the Advisory Committee of the Privy Council was outlined. From this Mr. Stothert passed on to a consideration of the labour question after the war. He supports the view that the restriction of output by the trade unions must be abolished and at the same time there must be no more avaricious employers. A better understanding between employer and employed can only be brought about gradually, and it therefore behoved everybody to make an effort to do something to this end. Finally, Mr. Stothert endorsed the demand that is being made all over the country for a Ministry of Commerce.

The Institution.—Sir W. Slingo, the Engineer-in-chief to the Post Office, has been elected a member of the Council of the Institution of Electrical Engineers in place of Capt. R. J. Wallis-Jones, retired on account of pressure of military duties.

Among the list of students elected at the last meeting of the Institution was Miss Lilian Entwistle, of Manchester.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

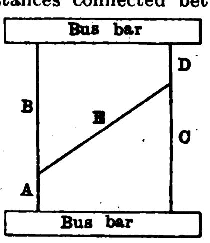
QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

ANSWERS TO No. 1,515.

What is the simplest way of calculating the equivalent resistance of a set of resistances connected between bus bars as per



diagram, and also the currents in the various parts. The letters represent the resistance of each part of the network.

The first award (10s.) is given to "S. A. S." for the following reply:—

The arrangement shown is simply an adaptation of the Wheatstone Bridge, the resistance E replacing the galvanometer. The usual and simplest method of calculating the equivalent resistance and also the current flowing in each branch is by the application of Kirchoff's and Ohm's Laws. The former states that in any branching network the algebraic sum of the currents at any junction is zero. Referring to Fig. 1, then the currents at the junctions X and Y are zero. That is, the currents flowing towards these points are equal to those flowing away. Resistance values, etc., are assigned as follows:—

$A=10$ ohms, $B=30$ ohms, $C=30$ ohms, $D=10$ ohms, $E=40$ ohms; P.D. between bus-bars $=220$ volts.

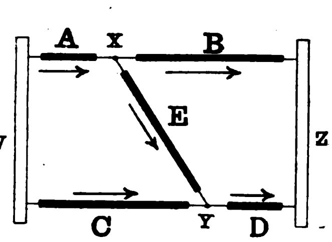


FIG. 1.

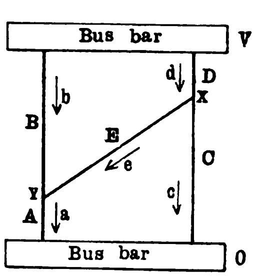


FIG. 2.

Then by the application of simultaneous equations we can determine the potential at the junctions X and Y, and consequently the currents flowing in the different branches.

Taking circuit WYZ:— $\frac{WZ-YZ}{C}+\frac{XZ-YZ}{E}-\frac{YZ}{D}=0.$

$$\text{i.e. } \frac{220-YZ}{30}+\frac{XZ-YZ}{40}-\frac{YZ}{10}=0 \quad \ldots\ldots\ldots (1)$$

Taking circuit WXZ:— $\frac{WZ-XZ}{A}-\frac{XZ-YZ}{E}-\frac{XZ}{B}=0.$

$$\text{i.e. } \frac{220-XZ}{10}-\frac{XZ-YZ}{40}-\frac{XZ}{30}=0 \quad \ldots\ldots (2)$$

Clearing of fractions and simplifying

$$(1) \text{ becomes } 3\,XZ-19\,YZ=-880 \quad \ldots\ldots\ldots (3)$$
$$(2) \text{ becomes } -19\,XZ+3YZ=-2640 \quad \ldots\ldots\ldots (4)$$

Solving (3) and (4)

$$XZ=150 \text{ volts.}$$
$$YZ=70 \text{ volts.}$$

Whence

$$WX=70 \text{ volts.}$$
$$WY=150 \text{ volts.}$$
$$XY=80 \text{ volts.}$$

The currents in the various branches are:—

$$\text{In branch } A=\frac{WX}{A}=\frac{70}{10}=7 \text{ amps.}$$
$$B=\frac{XZ}{B}=\frac{150}{30}=5 \quad ,,$$
$$C=\frac{WY}{C}=\frac{150}{30}=5 \quad ,,$$
$$D=\frac{YZ}{D}=\frac{70}{10}=7 \quad ,,$$
$$E=\frac{XY}{E}=\frac{80}{40}=2 \quad ,,$$

The equivalent resistance of the circuit is obtained by dividing the bus-bar P.D. by the total current flowing. The latter quantity is simply the sum of the two currents in branches A and C, and equal 12 amps. The equivalent resistance $R=\frac{220}{12}=18{\cdot}33$ ohms.

The second award (5s.) is given to "A. G. R.," who writes as follows:—

Let a, b, c, d, e be the currents in the various branches whose resistances are indicated by A. B, C, D, E, respectively, and X and Y be the voltage at the points indicated, and V the voltage across the bus-bars.

By Kirchoff's laws the algebraical sum of the currents at any junction is zero, therefore the sum of the currents at both points X and Y are zero (care being taken as to the signs), and the following equations are obtained:—

$$\frac{V-X}{D}-\frac{X}{C}-\frac{X-Y}{E}=0$$
$$\frac{V-Y}{B}+\frac{X-Y}{E}-\frac{Y}{A}=0$$

from which we obtain the values of X and Y, and further the values of the currents in the branches.

Now the *total* current flowing $=b+d$ or $a+c=I$ say.

Then the equivalent resistance $=\frac{V}{I}$

Example.—If A, B, C, D, E be 3, 9, 10, 2, 4 ohms respectively, and the bus-bar voltage is 250, then

$$\frac{250-X}{2}-\frac{X}{10}-\frac{X-Y}{4}=0 \quad \therefore \quad 17X-5Y=2{,}500$$
$$\frac{250-Y}{9}+\frac{X-Y}{4}-\frac{Y}{3}=0 \quad \therefore \quad -9X+25Y=1{,}000$$

From which $X=178$ and $Y=104$ volts.

$$\therefore \text{ Current } a=\frac{Y}{3}=34{\cdot}6 \text{ amps.}$$
$$,, \quad b=\frac{250-Y}{9}=16{\cdot}2 \quad ,,$$
$$,, \quad c=\frac{X}{10}=17{\cdot}8 \quad ,,$$
$$,, \quad d=\frac{250-X}{2}=36{\cdot}0 \quad ,,$$
$$,, \quad e=\frac{X-Y}{4}=18{\cdot}5 \quad ,,$$

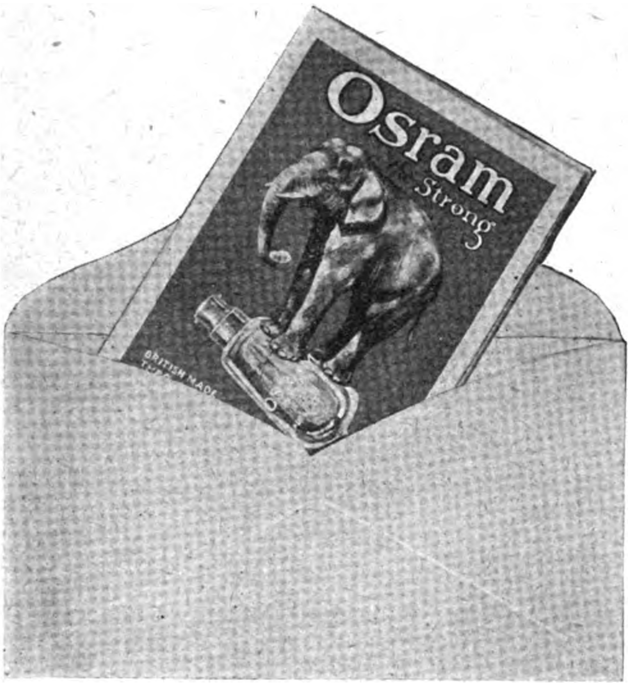
Hence total current $=52{\cdot}3$ amps, and equivalent resistance $=\frac{250}{52{\cdot}3}=4{\cdot}8$ ohms (nearly).

We have received a large number of replies of a high standard of merit. Several competitors have worked out the problem at considerable length mathematically, some using a neat method involving determinants. It must be borne in mind, however, that the practical engineer who sent us the question was in search of the *simplest* way of arriving at the result in his own particular case. [Ed., E. E.]

County of London Co.'s Advertising Design.—The design for an electric fire poster got out by the County of London Electric Supply Co. has quickly achieved a wide popularity. A large number of supply undertakings throughout the county have purchased copies of the poster, and by arrangement with the County of London Electric Supply Co. Messrs. Belling & Co. have used the design on the cover of their catalogues, of which about 100,000 have been issued.

A STRIKING LAMP ADVERTISEMENT

THE accompanying illustration shows the effective cover design of a new folder containing prices and particulars of all the ordinary sizes of standard, axial, and candle types of Osram lamps, which is being issued gratis to the trade, overprinted with any contractor's name and address, by the



General Electric Co., Ltd. (67 Queen Victoria Street). The elephant design is printed in colours from a picture by Mr. G. E. Studdey. The same design is also being printed as a window-bill, 20 in. by 30 in., which is being issued to the trade, and is remarkably effective.

Commercial Motor Vehicle Inspection.—The eleventh annual inspection of commercial motor vehicles and the examination of drivers organised by the Commercial Motor Users' Association will take place in London during May, 1917, but the usual parade of vehicles will not be held owing to the difficulty of sparing vehicles from service during the present period of stress. Full particulars and entry forms may be obtained from Mr. F. G. Bristow, Secretary, Commercial Motor Users' Association, 83 Pall Mall, S.W.

Institution of Electrical Engineers.—The following is the result of the ballot for new members at the meeting on Thursday:—*Member:*—D. M. Hutchison *Associate Members:*—Lieut. J. A. Baker, A.S.C., F. R. Baldock, G. R. Battle, R. S. Boyton, F. H Broomfield, Capt. P. Buckley, R.E., F. Clegg, Sec.-Lieut. R. W. Corbett, R.E. (T.), P. H. Fraenkel, A. Fraser, W. Fraser, E. Frere, H. J. Grapes, J. H. Hopton, J. L. Packer, C. F. Pallott, S. W. Redclift, Lieut. A. Rorke, R.E., A. D. Sloan, J. R. Smith, T. R. Thomas. *Graduates:*—B. N. Basu, N. Bowey, V. Brodsky, Si Yung Chang, A. C. de Oliveira, S. S. Iyer, E. S. Lane. *Students:*—A. Aldunate, Sec.-Lieut. C. M. Ballard, R.E., O. H. Bennett, R. D. Binnie, D. M. Buist, W. T. Burgum, L. P. Church, P. Clegg, J. S. Cowen, Miss G. Entwistle, H. J. Gibson, W. F. Gordon-Campbell, A. W. Grace, G. Gresty, E. E. Hopwood, D. B. Hoseason, C. L. Ives, J. Moffat, R. Osborne, J. F. Perry, W. G. Radley, P. A. Reily, T. S. Riley, A. H. Rogers, C. E. Storey, H. J. Tapsell, W. J. Thomas, C. V. Thornton, E. K. Wheatley, H. C. Wilkinson, S. K. Wilson, A. Wust.

Candidates Transferred:—From Associate Member to Member.—F. T. Chapman, D.Sc., W. P. Digby, Major B. C. Gardiner, R.M.L.I., F. J. Launchbury, T. H. Matthewman, B. G. White. *From Associate to Associate Member.*—H. B. Shepheard. *From Graduate to Associate Member.*—J. R. Danson, R. E. Golden, José Vaz Gomes, P. Grice, W. T. Hilder, L. O. Monson, F. R. Wilkinson. *From Graduate to Associate.*—T. H. Barr. *From Student to Associate Member.*—J. R. Abbott, H. Algar, Lieut. S. D. Anderson, R.E. (T.), E. P. Ashworth, F. C. Boa, R. Fruhe-Sutcliffe, H. J. Gwyther, L. D. Hill, Lieut. P. R. Hughes, R.F.A., R. N. James, A. Lisle, R. O. Martin, H. D. Phelps, R. C. Philipp, W. Ryley. *From Student to Graduate.*—A. M. Martins, M. Smith, D. Wilkin, A. Willcock, T. D. Williams.

FOREIGN MARKETS FOR ELECTRICAL GOODS

AT a time when so many people in this country are demanding a Ministry of Commerce, the following article, which appears in the New York *Electrical World*, will be interesting. It is written by a special agent of the American Bureau of Foreign and Domestic Commerce of the Department of Commerce, and is a good example of the way in which American trade is fostered. Incidentally, the article indicates the competition we shall meet when our own manufacturers can once more settle down to normal trading conditions.

Though American manufacturers of electrical goods are now enjoying a period of exceptional prosperity, and are manifesting a commendable willingness to enlarge the scope of their activity through the acquisition of foreign business, they are, as a matter of fact, securing only a small percentage of the export trade that should properly be theirs. To ensure an adequate and firmly rooted development in the future, two things are essential: first, the American makers must base their calculations on the obvious fact that many of their present orders from abroad are the result of the great dislocation in world economics produced by the European war. Second, they must strive diligently to adapt their output to the special desires of purchasers in distant lands; they must study with care and cultivate with discretion the vast foreign markets in which their endeavours should logically be rewarded by a gratifying and permanent success.

The situation is this: The export trade that American electrical manufacturers have to-day is mainly in Canada, South America, and Japan. The last-named country is beginning to make electrical goods of its own, and not only to supply its own needs to a certain extent, but also to meet the electrical manufacturers of the world in open competition in foreign markets. Japan is bringing its electrical goods into South America, into China, into Australia, and even into our own country.

The rich markets of the Far East, especially, are practically untouched by our export trade in this line. Moreover, our electrical manufacturers have laid no foundations for the future upbuilding of an export trade with these countries as they develop electrically. But there is, among such manufacturers, a rapidly-growing appreciation of the opportunities presented for developing a strong export trade, and a keener realisation of the absolute necessity for doing this and doing it at once.

A national association of electrical manufacturers, with a membership of about 250 representatives and associate representatives, recently mailed a *questionnaire* to each member company. This *questionnaire* requested the views of the member on foreign trade. The replies showed that 85 per cent. of the manufacturers desire to develop export trade. At the present time it is estimated that not more than 5 per cent. of them have any appreciable foreign business, and those that are now actually exporting are not furnishing any great amounts of the markets overseas. Notwithstanding the fact that their plants are operating now at their utmost capacity in practically all cases, and that in their best judgment they will be almost equally busy for at least two years to come, these executives still feel the necessity of extending their markets. With the changing world conditions, they must look for new markets, and the most promising field is abroad.

Many of these manufacturers have filled, or are filling, a certain number of foreign orders. In the majority of cases, however, the orders that have been received have been the result of inquiries made by foreign purchasers who were forced by war-time conditions to place orders wherever they could get them filled within a reasonable length of time. A few companies, to be sure, have for some time made a vigorous effort to secure export business, but on the whole it may be said that, outside of the larger electrical manufacturers who have established branch plants or offices abroad, little has been done in the way of a serious attempt to sell American electrical goods in foreign markets. A great many of the manufacturers have indicated their willingness to receive orders from abroad by appointing agents in foreign countries, but in most cases it appears that (before the war, at least) the principal result of their efforts was to place their prices and data in the hands of representatives of foreign manufacturers. Under existing conditions, therefore, we have the situation of foreign buyers coming to our manufacturers and expressing an urgent desire for our electrical products. We have not sold these in competition. The purchasers from abroad simply must have goods, and our manufacturers took the orders to the extent of their ability to deliver them.

Also, in probably the majority of cases the foreign pur-

chasers have had to take whatever our manufacturers could furnish them, and at our own terms. They have been forced to accept our standard apparatus and supplies, even though their purchases were to be used where standards and conditions were entirely different from our own. To a certain extent this gives our manufacturers an opportunity to develop a demand for our American standards, but it is questionable whether certain export fields, such as Latin America and China, will be able to develop electrically if they are compelled to accept only the higher quality, and accordingly higher priced, American standard apparatus and materials. For some time past Australia, New Zealand, and South Africa have demanded materials of good quality, but it is at least doubtful whether the Latin American market can be educated away from European electrical goods (which are generally cheaper than ours and inferior to them) to such an extent that our manufacturers, supplying the market with standard products used in American construction practice, can on that basis retain the export trade they have already built up and are apparently continuing to increase.

Many manufacturers seem to regard the present commercial conditions as normal. But in reality the present market is somewhat abnormal, and if they would retain the trade that is now theirs they must plan earnestly and judiciously for the future. By determining the requirements of the different markets and meeting them without undue sacrifice of manufacturing efficiency, they must lay foundations now upon which to build the structure of their export trade.

The foregoing does not mean that some of our electrical manufacturers have not already sought to meet the special requirements of their foreign customers. For instance, one manufacturer has developed a line of holders, plugs, and switches that have met with great success in South America, replacing similar European devices. This has not required a complete new line of special parts. In the holder, for instance, the outer shell and two porcelain items are new. The rest is made up of standard pieces such as are used in the ordinary grade of American holder. Comparing it even superficially with a European holder, it is at once apparent that the American product is superior. The manufacturer increases the production of his standard parts to a great degree, and still meets the requirements of this particular foreign market. His holder is actually far better than the European article, which formerly had the sale, and the manufacturer declares that he will be able to meet European competition in normal times, in spite of cartel-system buying and selling, long-time credits, etc., provided he is not placed at a disadvantage in the purchase of his raw materials.

In the apparatus line, also, manufacturers' associations are studying the requirements in the export markets, and developments are being made in the motor field with the view of furnishing standard lines rated in the same manner as are European motors. In export trade the practice of European manufacturers has been to submit motors rated on the basis of the maximum output, while in this country the practice is to give ratings that allow overload. This has naturally placed our manufacturers at a disadvantage in certain markets.

As a result of the *questionnaire* previously referred to, which indicated that 85 per cent. of the members of a manufacturers' association are on record as desiring to build up an export business, it is evident that our American electrical manufacturers are awakening to the possibilities of the broader markets. In the last two years they have experienced a period of tremendous activity. Their plants have been extended and their working forces increased. Through the effect of the European war not only has their domestic and foreign business been expanded far beyond peace-time limits, because of the military demand for materials of all classes, but, in addition, they have been called upon to supply markets that, prior to the war, were controlled by belligerent countries.

With the end of the war conditions will naturally change, and for these economic readjustments our manufacturers must be effectively prepared. Conditions to-day afford no dependable indication as to what may occur in the future when European manufacturers are again in full competition with our electrical factories in the export markets. It may reasonably be assumed that our production will fall off, at least temporarily. The extent of such a decrease will depend upon how soon, and how well, our electrical manufacturers take advantage of their unusual opportunities and meet the present and future demands of the purchasers abroad.

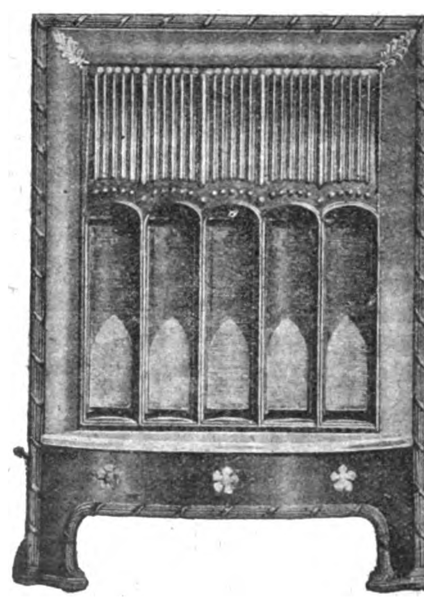
When an electrical manufacturer who has studied his foreign business is asked why he seeks export trade he may explain his position by tracing an up-and-down curve in space, saying that foreign business "smooths out his production curve." He has found that it tends to fill in the "valleys" in his production curve without increasing the "peaks." This, it need scarcely be said, is the condition that the manufacturer desires. The low sections of his production curve mean lowered manufacturing efficiency. If he can fill in the "valley" without material increase in the "peaks," he increases his annual output with the same general overhead expense, this last being practically the same whether he is operating at 75 per cent. of his capacity or at 100 per cent. The more he can run his plant at full capacity, the more he spreads his overhead charge and the lower the production cost. Foreign trade broadens the field from which the demand for his product comes. The broader the field the more uniform is the demand, the better the "load-factor" and the lower the cost of production.

Again, in certain lines, export business has a stabilising effect that is due to seasonal conditions. The domestic market for electric fans, for instance, varies with the weather that prevails during the summer months. A year or two ago, when the United States, in general, experienced a cold, rainy summer season, a great many manufacturers suffered greatly because the sale of fans was only a small percentage of the normal demand. They had the stock ready for the market as usual, but were compelled to carry a great proportion of it over to the next season. Abroad, weather conditions were more nearly normal, and the development of foreign trade would have relieved the situation somewhat. Also, whereas the domestic demand is practically all confined to the summer season, an export business in the tropics would make for a greater uniformity of production.

The value of export trade to American electrical manufacturers is apparent. They need only to study and to supply the requirements of foreign purchasers as they do those of our own country. The markets are open to development, and the American electrical manufacturers can and must develop them.

A NEW ELECTRIC FIRE

A NOVEL form of electric fire, bearing the name of the "Flamingo," has been introduced by the British Electric Transformer Co., Ltd. (Hayes, Middlesex). One form of this, in a handsome case, is illustrated in the figure. The heating elements of chrome-nickel resistance wire on steel trough frames with mica insulation are placed in an upright position. Owing to this and their particular shape a strong upward current of unequally heated air sweeps past the heated wires, and owing to the refractivities of the different layers, produces a beautiful shimmering effect resembling a flaming fire. A number of designs of the type of fire and other heating and cooking appliances are dealt with in a new list which we have received from the company.



THE "FLAMINGO" ELECTRIC FIRE.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published November 23rd, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

15,092/15. **Torpedoes.** H. A. von Post (Stockholm). An electrically-controlled dirigible torpedo connected to the base by a trailing conductor consisting of a wire reflexed upon or in a paper carrier ribbon, which is automatically paid out at a rate proportional to the rate of travel. The carrier breaks away bit by bit and frees the wire. The same wire which carries the control currents also transmits return signal currents, which actuate an indicator showing the movements of the torpedo.

15,237/15. **Wireless Telephony.** British Thomson-Houston Co. (*G.E. Co., U.S.A.*). A wireless telephone system employing a continuous wave producer of the electron discharge tube type in which the amplitude of the waves is varied in accordance with the sound-waves by varying the potential supplied to the tube.

15,261/15. **Hand Lamp.** L. Gaster and J. S. Dow. A portable lamp or torch which can only be made to give light when pointed in a downward direction. Included in the circuit is a sealed bulb containing a small quantity of mercury which only makes contact between two leading-in wires when the torch is pointed downwards.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: J. H. Collie [Troughing for electric conductors] 6.260/16 (*102,015*).

Dynamos, Motors, and Transformers: Zoelly [Electromagnetic power transmission gearing] 14,111/15; Walker [Commutator machines] 16,854/15.

Electrometallurgy and Electrochemistry: W. J. Wrightson [Electric furnaces] 2,584/16 (*100,093*).

Heating and Cooking: E. Erichsen [Heating apparatus] 7,275/16 (*102,020*).

Instruments and Meters: Merriman and Spiers [Supply meters] 16,058/15.

Switchgear, Fuses and Fittings: Rosebourne (formerly Rosenbaum) and Couse [Protective gear] 16.053/15; Marks (*Bunken*) [Lightning arrester] 16,056/15; Fildes [Lampholder connections] 17,060/15; W. Donovan [Switch lampholders] 4,752/16 (*102,012*).

Telephony and Telegraphy: Marr [Telephone plugs] 14,742/15; Mellerst-Jackson (*Western Union Telegraph Co.*) [Telegraph apparatus] 15.579/15; A. and L. D. Williams [Telephone receiver] 2.242/16 (*101,996*).

Traction: British Thomson-Houston Co. (*G.E. Co., U.S.A.*) [Electric vehicles] 17,128/15.

Miscellaneous: British Thomson-Houston Co. (*G.E. Co., U.S.A.*) [Circuit connections of electron discharge apparatus] 15,448/15; Langdon-Davies, Soames and Naamlooze Vennootschap de Nederlandsche Thermo-Telephon Maatschappij [Electrically controlled clutches] 15,752/15; Pordes [Portable lamps] 16,290/15; Campbell [Regulating systems] 17,166/15; Parsons and Ball [Reversible step by step ratchet mechanism] 17,570/15; H. Wrigley [Electric lighting system or circuits] 358/16 (*101,985*); S. Dushman [Electric discharge vacuum tubes] 2,328/16 (*100,104*); A. H. Railing and A. E. Angold [Miners' lamps] 2,552/16 (*102,001*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Electrochemistry: F. G. Wheeler [Electrolytic cells] 15,137 (*102,049*).

Ignition: J. F. Alvord and W. B. Thompson [Igniters] 15,464/16 (*102,058*); M. C. E. Bundy [Sparking plugs] 15,350/16 (*102,054*).

Miscellaneous: Crucible Steel Co. of America [Electric sinetic gyroscopes] 11,769/16 (*102,044*).

Opposition to Grant of Patents

4,862/15. **High Frequency Apparatus.** H. R. Rivers Moore. The grant of a patent upon this application has been refused on account of opposition. The specification describes a system of producing high-frequency currents in which an inductance in parallel with a condenser is periodically short-circuited by a revolving contact maker.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

26,552/02 and 26,553/02. **Wireless Telegraphy.** R. A. Fessenden. The first of these describes methods of single, duplex, and multiplex wireless working, and the second a form of receiver in which a rotary magnetic field is disturbed by the sudden impulse due to the receipt of electric waves.

26,868/02. **Meters.** A. Wright. Electrolytic meters with mercury electrodes.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: T. J. Rensing [Ventilator for arc-lamp globes] 16,797/08.

Dynamos, Motors and Transformers: C. A. Parsons and A. H. Law [Slotted turbine rotors with auxiliary conductors in parallel with each armature bar in the air-gap to reduce self-induction] 11.822/09.

Incandescent Lamps: W. D. Coolidge [Squirting tungsten filaments with a binder of cadmium-lead amalgam] 16,534/05.

Miscellaneous: S. E. Flechtner [Mercury vapour lamps] 17.166/04; Ozonair, Ltd., and E. L. Joseph [Portable ozoniser] 16,392/05; C. E. A. Holdsmith [An attempt at obtaining perpetual motion] 18,511/09.

British Prisoners of War Book Scheme.—This war charity—the officially recognised medium for providing British prisoners of war with books for purposes of serious study—makes an urgent appeal for works on electrical engineering to meet actual requests received from British prisoners (soldiers, sailors and civilians) interned in enemy or neutral countries. Among the special books asked for this week are:—"American Electricians' Handbook," "Steam-Electrical Handbook," "Civil Engineers' Pocket Book" (Trautwine), "Modern Electric Practice," "Electrical Engineering" (Slingo and Brooker), "Electrical Engineer's Pocket Book" (Foster), "Applied Electricity" (Hobart), and "Power-House Design." Readers who may be able and willing to contribute one or more of the above works to this excellent war charity are invited to forward to Mr. A. T. Davies, at the Board of Education, Whitehall, London, S.W., a list of the books they can offer. They will then be notified as to the acceptance of their gifts. Further particulars of the book scheme may be had on application.

Obituary.—Sir George White, whose death took place suddenly on Wednesday last week at Bristol, was well-known in electric traction circles. In conjunction with the late Sir Clifton Robinson, he introduced the first electric tramways into London, namely, the London United Electric Tramways Co., and was also associated with the late Sir Clifton in substituting electricity for animal traction on a large number of other tramway undertakings throughout the country. As an instance of his foresight may be mentioned the formation of the British and Colonial Aeroplane Co. at Bristol in the early days of aviation. Subsequent events have fully justified that action.

Electrical Units and Standards.—We have received a copy of a new publication of the American Bureau of Standards (Circular No. 60), entitled "Electric Units and Standards." This gives comprehensive and up-to-date information regarding the units and standards in terms of which electric and magnetic measurements are made. It includes the history of the units and the evolution of the definitions upon which the laws on electrical standards are based. The laws on the subject of American and other countries are given. These laws are in substantial agreement, and the various national bureaux of standards co-operate in maintaining the fundamental standards. The circular gives conversion factors, by means of which measurements may be expressed in any desired unit. All this information on electric units and standards had not previously been available in a single publication. The publication, which is a booklet of 68 pages, is now ready for distribution, and those interested in the subject may obtain a copy free by addressing a request to the Bureau of Standards, Washington, U.S.A.

THE EFFECT OF THE EUROPEAN WAR UPON AMERICAN INDUSTRIES

AT a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers, in Chicago recently, Mr. C. P. Steinmetz discussed the effect of the European war upon American industries. In opening, says the *Electrical Review* of Chicago, he traced the progress of civilisation through various eras, showing that the American and French Revolutions by their declarations of the rights of man ushered in the present industrial era. The resulting development of individual initiative led to the great inventions of the past century, all of which through their labour-saving characteristics made men and nations capable of producing more than they consumed. As soon as this point was reached it was a problem either of reducing production, and thereby facing bankruptcy, or of finding new markets.

England was the first distinctively industrial nation. It found markets for its surplus goods abroad and the income from its foreign trade was largely invested abroad, making it the leading financial power of the world. Germany developed industrially with great rapidity and also found markets abroad, its surplus capital being invested in foreign fields at very low rates, because it was not required at home. England is the most individualistic nation and Germany the most co-operative one. The latter's industrial development is due in large degree to the extremely high economy obtained by mass production, embodying the most advanced scientific methods and governmental policies to promote industry and commerce. The result is shown in the extraordinary efficiency with which Germany is conducting the present war against very heavy odds.

This war will leave an entirely different Europe. Already England and France are adopting Germany's methods to promote industrial efficiency and economy. When war is concluded a most profound change will take place in all international trade. Regardless of any temporary checks due to protective tariffs, those countries will dominate foreign commerce that will be able to produce commodities in the most economical manner. America must awaken to the necessity of developing all its industries to the highest state of efficiency and maximum economy. This involves production on a large scale and complete control of production and prices, so as to avoid flooding the markets. This means giving extraordinary power to those controlling the industries. To prevent abuse of this power either governmental restrictions may be necessary or, better yet, such an organisation of industries as will make it financially inexpedient to abuse power. It also will require a thorough co-operation between all elements in an industry, *i.e.*, fully as complete harmony between the management and the shop employees as now almost invariably exists between the management and the office employees.

LOCAL NOTES

Birmingham: *Supply Difficulties.*—The continued interruptions to the tramway supply at Birmingham was the cause of considerable discussion at the last meeting of the Corporation, but it is now hoped that the Electricity Department will be able to give sufficient power to enable a reduced service of cars to run during the hours at which at present the stoppage is total. Rapid progress is being made in the repair of the plant at the Nechells power station, whilst it is anticipated that a new 6,000-kw. turbo-alternator will be installed during December.

Calcutta: *Electric Supply Charges.*—According to the *Englishman*, the Bengal Government has appointed a Committee to inquire into the question of the present charges for electric supply of the Calcutta Electric Supply Corporation. The Committee commenced its sittings on November 8th.

Exeter: *Electric Lighting Connections.*—Having regard to the recent Government restrictions upon the manufacture of electric cable, Mr. H. G. Munro, the Borough Electrical Engineer, has reported to his Committee the difficulty of replenishing the Corporation's stock of cable, and has intimated that when the present stock is used up no new consumers can be accepted.

London: *Hammersmith.—Battersea-Fulham-Hammersmith linking-up:* Negotiations are still being carried on with the Battersea and Fulham Borough Councils with regard to the proposed linking-up scheme approved by the Council in June 1915. In the meantime a suggestion has been received from the Fulham Borough Council that it would be a convenience to them if Hammersmith could take over some of their load and carry it for a period of six months or so, pending the carrying out of certain important alterations at the Fulham Council's electricity works. The engineer has reported that this can be done, not only as a temporary measure to give immediate assistance to the Fulham Council, but in such a way as to form a part of the proposed larger and permanent linking-up scheme. The suggested temporary scheme consists in connecting the ordinary high-tension mains at a sub-station in the Fulham area near the Hammersmith boundary. The necessary cable, which it is proposed to take out of stock, at an estimated cost of £150, will be drawn into a short length of the ducts required for the permanent linking-up. The only apparatus to be purchased are two auto-transformers necessitated by the difference in the two pressures of the Hammersmith and Fulham undertakings. This will enable a temporay bulk supply of approximately 400 kw. to be given to Fulham. It is estimated that the cost of the work, which will be undertaken by the Fulham Council, exclusive of the cost of cables, which will be supplied from this Council's stock, is £200, one moiety of which cost will be payable by this council. The charges to be made by the Hammersmith Council to the Fulham Council for the current supplied under this proposal will be in accordance with the charges to be fixed by the proposed linking-up agreement in respect of a bulk supply.

Islington: Employees' Wages.—The dispute between the Council and its employees at the electricity works recently referred to in our columns regarding wages has been settled by the granting of an additional penny per hour, except to leading stokers, outside labourers, and gangers, who were recently granted an increase of wages. The annual cost of this addition to the employees' wages is £1,000.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Australia.—The Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, has a copy of the specification, drawings, and conditions of contract in connection with the call for tenders by the Deputy-Postmaster-General, Sydney, for an oil engine and generator, switchboard, and accumulators. As tenders have to be in by December 14th, this information is only of use to firms who can cable agents.

Dundee.—The Scottish Office has approved the application of the Corporation for additional borrowing powers of £27,000 on condition that £5,000 of this is provided out of revenue and a 4 per cent. sinking fund set aside to repay the remainder. In reporting this matter at the last meeting of the Committee, the Convener said it would probably result in the charges for electricity having to be increased next year.

London: *Hammersmith.*—The Council having considered the question of making financial provision when called upon to do so to meet the obligation to the Chiswick Electricity Supply Corporation, Ltd., to take over the cable and apparatus laid in connection with the bulk supply to the Chiswick Co., on the termination of the contract for supply, at the agreed price of £2,000, recommends that application be made to the L.C.C. for sanction to the necessary loan. It is not anticipated that any difficulty will be offered by the Treasury to this, having regard to the fact that the bulk supply is required solely for war purposes, and that it is not anticipated that it will be necessay to take up the loan for some little while.

An expenditure of £250 is contemplated in connection with arrangements for taking over part of the Fulham Borough Council's load for a period of six months. (See "Local Notes.")

Miscellaneous

L.C.C.—The Council require about 3,000 yards of tramway trolley wire.

Trading with the Enemy.—The Board of Trade has issued an order requiring the winding-up of the Sanitas Electrical Co., Ltd., 61 New Cavendish Street, London, dealers in medical electrical apparatus.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night was £166 to £169 (last week, £161 to £163).

A Siemens' Wounded Soldiers Entertainment.—A party of 300 wounded soldiers were entertained by the employees of the Siemens Dalston Lamp Works on Saturday, November 18. The Charrington Hall, St. Pancras, was kindly lent for the occasion by Mr. Hopkins, and every possible arrangement made to ensure the comfort and amusement of the guests. Nine motor 'buses were provided by Mr. A. Pegley, of 22 Lea Bridge Road, to convey the men from the various hospitals to the hall. The entertainment, which consisted of a concert, tea and dancing, commenced at 2 p.m. The ladies of the Wotan Lamp Works had an opportunity of proving that they take a keen interest in social affairs, and we understand that each of the wounded "Tommies" had the attentions of a lady. A good proportion of the talent for the concert was drawn from the Dalston works staff, but several professional friends readily gave their assistance, Tea was served at 4 p.m., after which the hall was cleared for dancing. At about 6.45 the soldiers were conveyed back to their respective hospitals. Incidentally, 200 of the party were from the King George's Hospital. It is hoped that this function will be one of a series of similar entertainments, and it was undertaken at the initiative of the work-people themselves.

Change of Address.—The Government having taken over Canada House, Kingsway, W.C., the Fuller Electrical and Manufacturing Co. has removed to Old Sergeant's Inn Chambers, 5 Chancery Lane, W.C. The telegraphic address and telephone number remain as before, viz., "Fullmage, London," and Holborn 1441.

APPOINTMENTS AND PERSONAL NOTES

The Leeds Electricity Department require a Chief Engineering Assistant at a salary of £350 per annum. Applications to C. N. Hefford, Manager, by December 9th.

The Northampton Institute (Clerkenwell) requires a full-time Demonstrator in Electrical Engineering and Physics Department (see an advertisement on another page).

An Electrical Engineer is required to take charge of plant of a saw mills (see an advertisement on another page).

Messrs. De Trey & Co. want an Electrician (see an advertisement on another page).

City of Birmingham Electricity Department want a Boiler-house Shift Engineer (see an advertisement on another page).

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

British Electric Traction Co.—The dividend for the half-year to September 30th has been declared on the 6 per cent. Cumulative Participating Preference stock.

Edison Swan Electric Co.—At the annual meeting last week the report and accounts given in our issue for November 16th, page 438, were adopted. Mr. C. J. Ford, the chairman, said that during the past year the turnover had been larger than in any year since the Company started business, and the profit had increased from £14,000 in the previous year to £24,000. The engineering side of the Company had been employed almost entirely on Government work at moderately remunerative prices, whilst the lamp works had been fully employed as far as the restricted labour conditions permitted. Sales of lamps had largely increased, and but for the extra cost of labour and raw materials the profits would have shown a still further improvement. The Company, however, was urgently in need of further capital, and it was for this reason that no dividend was declared this year. Of the £24,000 profit, £16,000 had to be employed in providing additional plant and machinery to cope with the increased business. At the same time, negotiations had taken place with some of the larger shareholders and debenture stockholders, and a scheme would shortly be put into operation for providing further additional capital.

NEW COMPANIES

TYNE ELECTRIC STEEL FOUNDRIES, Dunston-on-Tyne. Capital, £39,750 (35,000 £1 Preference and 95,000 1s. Ordinary). To take over the business of the Electric Flex Steel Co., Ltd., and to adopt an agreement between W. Swan and R. P. Sloan. The subscribers include R. P. Sloan, Newcastle-on-Tyne Electric Supply Co.

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SUMMARY

Some particulars are given of a steel rolling mill in America driven entirely by electrical energy derived from water-power (p. 458).

Two Patent specifications relating to electric miners' lamps were published during last month, and one connected with shaft signalling. The electro-metallurgical specifications include one for an electric furnace (p. 459).

The Government have decided to establish a Department of Scientific and Industrial Research for Great Britain and Ireland under the Lord President of the Privy Council. An influential deputation waited on Friday upon Lord Crewe with regard to the question of increased Government grants for scientific and industrial research, when it was indicated that a considerable sum of money, estimated to be sufficient to meet all the requirements in this direction for four or five years, will be granted by the Government, in addition to annual grants for other purposes in the same connection. One of the essentials of the scheme, however, is that industries should contribute, and for this purpose the formation of special associations, or branches of existing associations, is proposed to which members of any particular industry will contribute (p. 460).

A question connected with the effect of sea-water on accumulators is offered for competitive replies in our Questions and Answers columns (p. 462).

In his Chairman's address to the Newcastle section of the Institution of Electrical Engineers recently, Mr. J. H. Clothier surveyed the progress that has been made with armour-clad switchgear of the "draw out" type (p. 462).

Among the subjects of Specifications published at the Patent Office last Thursday were feeder protection magnetic clutches and dynamos (p. 463).

Further increases in electric supply charges are to be made at Birmingham and Wrexham.—A Trade Profits Special Committee has been appointed at Manchester to deal with the finances of the various trading departments (p. 464).

A turbo-alternator set is required at Sunderland (p. 464).

An issue of £100,000 7 per cent. participating preference shares is to be made by the Edison Swan Electric Co. (p. 464).

NATIONAL ELECTRIC POWER SUPPLY

A meeting was held last week of the supply station engineers in the South Wales and Monmouthshire area scheduled by the Joint Committee on National Electric Power Supply. Mr. W. A. Chamen, of the South Wales Electrical Power Distribution Co., was in the Chair, and it was resolved to appoint a local committee with Mr. Arthur Ellis, City Electrical Engineer at Cardiff, as Chairman; and Mr. L. W. Dixon, Managing Engineer of the Merthyr Electric Traction and Lighting Co., as Vice-Chairman and Hon. Secretary. The following sub-committee was also appointed:—Messrs. W. A. Chamen, W. Burr (Swansea), A. Nicholls Moore (Newport), G. H. Thomson (Neath), J. E. Teasdel (Pontypridd), J. M. Bowman (Porth), and J. C. Howell (Llanelly). The Secretary has been instructed to communicate with the various authorities with a view to obtaining certain information, and then to arrange for a meeting of the sub-committee.

Mr. J. W. Hame the York City Electrical Engineer, has reported upon the proposal to inter-connect the various supply stations in Yorkshire, and has expressed the opinion that any such scheme will be of no advantage to York. His reason for this is that York is surrounded largely by agricultural areas, the nearest towns where there are supply stations of any importance being Leeds, Hull and Harrogate. The distances between these towns is such that Mr. Hame is of the opinion that the cost and labour involved in carrying out a linking-up scheme would make inter-connection impracticable at the present time. The York undertaking, says Mr. Hame, is more likely to be benefited by the transference of much of the power now generated by private plants in the City to the Corporation's supply station. As a matter of fact, negotiations with several large users of power are being carried on, but so far as a main linking-up scheme is concerned it is not thought that the time has come when York can benefit by it.

1st LONDON ENGINEER VOLUNTEERS

Headquarters, Chester House, Eccleston Place, S.W.
Orders for the Week by Lt.-Col. C. B. Clay, V.D., Commanding.

Officer for the week.—Platoon Commander Parker.

Next for duty.—Platoon Commander C. H. C. Bond.

Promotion.—Orderly Room Corporal Hardcastle to be Sergeant (dated Dec. 1st).

Monday, Dec. 11th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon drill, Platoon No. 10. Signalling class. Recruits' drill, 6.25 to 8. Lecture on telephones, 7.30.

Tuesday, Dec. 12th.—School of arms, 6 to 7. Lecture, 7.15, "The Service of Protection," Coy. Cmdr. Hyman.

Wednesday, Dec. 13th.—Instructional Class, 6.15. Platoon drill, Platoon No. 1.

Thursday, Dec. 14th.—Platoon drill, Nos. 5 and 6. Ambulance Class by M.O., 6 o'clock.

Friday, Dec. 15th.—Technical for platoon No. 10, Regency Street. Squad and Platoon drill, No. 9. Signalling class. Recruits' drill, 6.25 to 8.25. Lecture on Telephones, 7.30.

Saturday, Dec. 16th.—N.C.O.'s Class, 2.30, Coy. Cmdr. Hyman.

Sunday, Dec. 17th.—Entrenching at Otford. Parade Victoria (S.E. & C. Ry. booking office), 8.45 a.m. Uniform, haversacks, water-bottles Midday ration to be carried. Railway vouchers will be provided.

Arrangements for the Week.—*Saturday, Dec. 9th.* Chief Technical Assistants' Association, Tavistock Hotel, Covent Garden. Discussion on "Coal and Ash Handling Plant." 3 p.m.

Birmingham and District Electric Club.—Annual meeting at Swan Hotel, New Street. 7 p.m.

Monday, Dec. 11th.—Institution of Electrical Engineers, Western Section. Meeting at South Wales Institute of Engineers, Park Place, Cardiff. Dr. Alexander Russell will deliver the Kelvin Lecture. 5 p.m.

Tuesday, Dec. 12th.—Association of Supervising Electricians at St. Bride Institute, Ludgate Circus. "Electric Meters," by J. Renny. 7.15 p.m.

Institution of Electrical Engineers, Scottish Section.—Meeting at 207 Bath Street, Glasgow. Mr. J. S. Peck will read his Paper on "Parallel Operation of Power Stations."

Institution of Electrical Engineers, Manchester Section, at Engineers' Club. "Some Aspects of Industrial Research with Special Reference to American Research Activities," by A. P. M. Fleming. 7.30 p.m.

Wednesday, Dec. 13th.—Association of Engineers-in-Charge, St. Bride Institute, Ludgate Circus. "Solid Fuels," by S. G. Martlew. 8 p.m.

Thursday, Dec. 14th.—Institution of Electrical Engineers. "Colonial Telegraphs and Telephones," by R. W. Weightman. 8 p.m.

ELECTRICAL ENGINEERING IN THE MINING AND METAL INDUSTRIES

Published on the First Thursday of each month

ELECTRICITY IN AN AMERICAN ROLLING MILL

AN article by Mr. W. L. Berry in the *Electrical Review and Western Electrician* describes an interesting example of a steel rolling mill running on energy purchased from an electrical power company. This is the mill of the St. Louis Screw Company, which purchases power for all its requirements from the Union Electric Light & Power Company of St. Louis.

Electrical energy is supplied to the 4,000 horsepower installed in the rolling mill from the great hydroelectric plant on the Mississippi River at Keokuk, Iowa. It enters the substation of the St. Louis Screw Company in the form of 13,200-volt, three-phase, 25-cycle alternating current. Within the substation are nine transformers together with the necessary lightning arresters, oil switches, panel-boards and a motor-generator set to supply direct current to the crane and monorail system. There are three 300-kva transformers with a secondary voltage of 2,200 supplying service for the operation of the steel-mill motors, totalling 2,250 horsepower. Three 150 kva. transformers, secondary voltage 440, supply a miscellaneous motor load of about 1,800 horsepower. Three 20-kva transformers, 230-115 volts secondary, answer the lighting requirements of the plant. All transformers are of the single-phase, oil-insulated, water-cooled, indoor type.

The three mills now installed are an 18-inch finishing mill, a 14 by 9 inch finishing mill and a 20-inch puddle mill. Each of these is driven by a 600-horsepower slip-ring motor with variable speed, reversing control. The 14 by 9 finishing mill is operated by a 15-strand rope drive, but with the other two mills Morse silent-chain drive is used. The drive consists of two separate chains, each 17 inches wide. A fourth mill, 10 by 8 inch finishing, has not yet been installed but will be within the next year.

Two kinds of scrap iron are brought into the mill on railway lines, puddle scrap and "bushling" scrap. The puddle scrap is transferred to the puddle mill where it is rolled into flat bars, cut into short lengths by shears and moved to the fagot-making department. The bushling scrap is dumped into the scrap yard where there is a battery of ten motor-driven shears of all sizes, ranging in electrical capacity from 10 to 100 horsepower. These shears cut the scrap into small lengths, and it is then raised by means of an electro-magnet into raised bins located along the end wall of the plant. Under these bins is located a track along which an electrically driven tumbler and rust collector operates. This tumbler moves from bin to bin, taking its charge of scrap, cleaning it, collects the rust in a separate receptacle, discharges its load at the end of the operation, and is then moved along the track by an electric motor to the next bin. The rust is removed from the tumbler by means of a blower, and is discharged from the rust collector into a bin provided for the purpose. This rust is sold to gas manufacturing plants for purification purposes.

After the scrap is cleaned it is made up into fagots. These are made by tieing four flat bars from the puddle mill together with iron wire and filling the inside with cleaned bushling scrap. The fagots are wheeled on hand cars to the furnaces where they are brought up to a welding heat. They are then removed from the furnace with the aid of a pull-out machine which is direct connected to a 5-horsepower motor by means of a worm gear, and are passed to the rolling mills. After passing through the mill, the rolled steel is dragged into position opposite the cooling bed by a motor-driven pull-over machine. Motor-driven conveyors with raised fingers then drag the material into place on the cooling bed. These conveyors also force the cooled material into a runway where motor-driven rolls propel it to the shears. Here the material is cut into proper lengths and is taken to the warehouse by means of a five-ton crane. From the warehouse the material is either shipped out for the trade or is transferred by the crane to other departments for the manufacture of the company's product of nuts, bolts and screws.

A complete coal pulverising plant is installed. This consists of a Raymond pulverising mill direct-connected to a 100-horsepower motor, a tube mill geared to a 200 horsepower motor and two heating furnaces belt driven by two 20-horsepower motors. The tube mill will eventually be replaced by a second Raymond mill. The coal-handling system might be also of some interest. Slack coal is brought into the plant on a railroad switch over which the monorail system extends. It is transferred from the cars to the coal hoppers by means of the clam-shell bucket of the monorail system. From the hopper the coal drops into the Raymond mill. Here it is pulverised and agitated. A forced draught of air from a blower carries the finer particles through a screen into the dryer. By means of the coal-fired furnace of the drying machine all the moisture is removed from the powdered coal which is discharged into a bucket conveyor. This elevates it and dumps it into a screw conveyor, which deposits the coal into bins near each furnace. Leading from these bins are spouts connecting with screw conveyors, which force the coal into the furnace. Near the entrance to the furnace a forced draft of air is applied to the powdered coal with the result that it is sprayed into the combustion chamber in a manner very similar to an oil-fired furnace.

The screw department is at present a short distance away from the rolling mill, and is operated by an isolated direct-current plant. This department will be moved to the rolling mill and will employ about 450 horsepower in alternating-current motors. The nut department with a connected load of 169 horsepower is now being erected. The 10 by 8 inch finishing mill is not yet installed, but will employ a 350-horsepower motor on the roughing rolls and a 100-horsepower motor on the finishing rolls. The crane and monorail system, for which power is supplied by the 50-kilowatt motor generator set in the transformer substation, is very complete and connects all parts of plant together.

THE "T.K." MINERS' ELECTRIC LAMP

SOME improvements in the usual design and construction of miners' lamps are claimed for the "T.K." miners' lamps made by Messrs. Turquand and Kew (Albion House, New Oxford Street, London). These lamps are supplied with interchangeable batteries of either the acid or alkaline type, and the batteries are not loose in the shell, but are gripped between the upper and lower case with a resilent support underneath. Other features of these lamps are an outer shell of stamped steel heavily leaded to prevent corrosion and provided with water and gas-tight joint hermetically sealing the lamp. The glass is a plain domed glass having no flange or neck to crack or break, held in position by pressure on the top by tension rods. There is a strong magnetic lock, concealed within the lamp avoiding projecting parts. The lamp is held in a patent concentric bulb-holder, whilst the reflector and switch are combined, the circuit being only broken within a gas-tight chamber. This reflector and switch can be renewed within a few seconds without dismembering the lamp, which is supplied in two sizes; one weighs about 4¾ lb. and gives a candle-power of 1–1·5 for about ten hours, or 2–3 candle-power for about six hours; and the second weighs about 5½ lb. and gives 1–1·5 candle-power for 20 hours or 3–4 candle-power for nine hours.

ELECTROLYTIC PREPARATION OF COPPER

According to an American contemporary, *Metallurgical and Chemical Engineering*, a new apparatus for electrolysing copper solutions has recently been patented in the United States by W. E. Greenwalt. The main objects in view were the more efficient application of the electric current, the retarding of the disintegration of the electrodes, keeping the electrodes free from polarising agents, and maintaining the apparatus in continuous operation for extended periods. The main features employed are: the separating of the anolyte and catholyte by means of a diaphragm, thorough agitation of the electrolyte and the addition of depolarisers, and the automatic removal of anode slimes. The cell is of the horizontal type. The main chamber contains a horizontal cathode and the catholyte. Into this is placed the independent porous anode bell, so constructed, that it may be differentially oscillated by some mechanical device. The anode compartment is an independent unit, and may be bodily removed from the cell. The oscillating motion serves to automatically agitate the electrolyte, to clean the anodes, and to collect the anode slimes at one end of the anode chamber, permitting the easy removal of the slimes. The diaphragm also diminishes the fouling of the cathode electrolyte. The depolariser added is usually sulphur dioxide. The automatic handling of the anode slimes and the foul electrolyte makes it possible to increase the period of operation. The following new facts have been demonstrated by the use of this new cell:—First, the amount of lead peroxidised at the anode, on using lead anodes was reduced from 1,600 lb. of lead to 40 lb. per ton of copper; and, secondly, abnormally high current densities could be employed, *i.e.*, 104 amperes per square foot gave an efficiency of 99 per cent.

ELECTRIC STEEL FURNACES

At a recent meeting of the Sheffield Society of Engineers Mr. H. Etchells gave a lecture on the practical working of electric steel furnaces. He said that successful operations depended more on the skill of the metallurgist than the workman, as there was more difficulty in keeping to an accurate specification than with a furnace such as the Greiner's open-hearth furnace. One of the chief difficulties was the breaking away of the silica bricks of the wall of the furnace after the start of the oven, because the fused silica attacked the dolomite of the hearth. A basic roof material was needed. Experiments in that direction had been made with bauxite, but with indifferent success. Comparing the efficiencies of small and large furnaces, he said that the cost of repairs in both was about 10s. per ton of steel. The cost of melting the steel in the small furnace was about £10 per ton and in the large furnace down to £6 per ton. The electric furnace meant economy in steel production, for there was less waste. Steels of intricate composition which, in the crucible, could only be made from the highest quality materials, in the electric furnace could be made from scrap.

ELECTRIC STEEL FURNACES IN FRANCE

An article in a recent issue of *L'Echo des Mines et de la Métallurgie*, abstracted in the *Iron and Coal Trades Review*, suggests the installation of electric furnaces in towns, in order to utilise the electric units lying idle at the power station during slack time. The author saw the first installation of this kind about eight years ago in a suburb of Turin. There were two small Stassano furnaces of 100 h.p. each, and two of 1,000 h.p. each, both taking their current direct from the town supply. In France the idea is making headway. Just outside Limoges a Keller furnace has recently been installed capable of smelting down 30 tons of iron turnings and other cheap scrap per day, and producing 25 tons of high-priced cast metal, in conjunction with dephosphoration or without it, or turning out ordinary cast-iron of high quality when the current is obtainable at a low rate. The furnace occupies a very small space in the tramway depôt, and requires little attendance owing to the provision of ample labour-saving appliances. The current in this case is transmitted from a hydraulic power station to Limoges at 30,000 volts, where it is transformed down to 10,000, and then again to 110 volts to suit the voltage of the furnace. The consumption of current is about 700 to 800 kilowatt-hours per metric ton of metal produced. The first heat would, it is presumed, have to start about midnight, or soon after the peak-load is passed at the power station.

New Safety Lamps.—The Secretary of State for the Home Department has approved the "Kingsway" Miners' Electric Safety Lamp; the "Davis-Edison Accumulator" Miners' Electric Safety Lamp; the Cambrian Officials' Lamp, No. 7; and Pearson's Officials' Pocket Lamp.

ELECTRICAL MINING AND METALLURGICAL PATENTS OF NOVEMBER

Mining.

Among the Patent Specifications of interest to mining electrical engineers published during last month at the Patent Office was one numbered 15,094 of 1915, by T. J. Thomas, for an attachment to electric miners' lamps to render them capable of serving as indicators of firedamp. The lamp circuit includes a resistance made of a catalytic material which becomes heated when inflammable gas is present, and by its alteration in resistance visibly affects the strength of the light. In extreme cases the material fuses and extinguishes the lamp by breaking the circuit.

Another miners' lamp specification is that numbered 102,001, according to the new system of numbering, by A. H. Railing and A. E. Angold. This describes an improved arrangement of battery contacts and switch apparatus. A combined switch and spring-controlled pressure plate is used, together with rigid battery terminals, so that pressure is maintained in all positions of the switch, the current being conveyed to the lamp leads by the springs.

No. 16,050 of 1915, by F. Hird, deals with shaft signalling apparatus, and provides for an improved attachment to the winding engine to cancel the order as soon as the engine starts to move.

Metallurgical.

W. J. Wrighton, in No. 100,093 (new numbering), describes an electric furnace for producing temperatures of the order of 1,800 deg. F., wherein is provided a heater compressing an active layer consisting of a resistance conductor embedded in plates of a refractory material having substantially the same coefficient of expansion as the resistance metal.

SCIENTIFIC AND INDUSTRIAL RESEARCH

LORD CREWE, Lord President of the Privy Council, and President of the Committee of the Privy Council on Scientific and Industrial Research, received at the Institution of Civil Engineers on Friday a deputation from the Conjoint Board of Scientific Societies. This latter is a newly-formed body to promote co-operation between those engaged in pure science and those engaged in industrial applications of science, and the object of the deputation was to impress upon the Government the necessity for greatly-increased contributions from the State for research work generally. Lord Crewe was accompanied by several members of the Committee of the Privy Council and of the Advisory Council, and, in addition, among those present were Sir Joseph Thomson, F.R.S., Sir John Snell, Mr. W. Duddell, F.R.S., Professor J. Perry, F.R.S., Lord Moulton, Professor W. H. Eccles, Dr. R. T. Glazebrook, F.R.S., Dr. Alexander Russell, Professor E. Wilson, Professor J. A. Fleming, F.R.S., Dr. R. Mullineaux Walmesley, and Mr. W. R. Cooper.

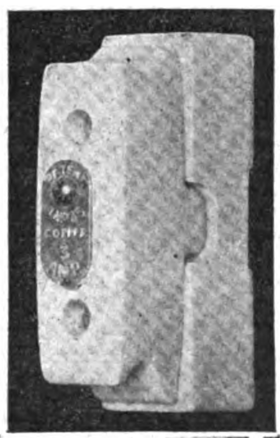
Sir Joseph Thomson, who led the deputation and spoke in the interests of research in pure science, said that pure science is the seed of applied science, and neglect of pure science would be on a par to spending a large amount of money on manuring and ploughing land and then to omit to sow any seed. Research work in applied science in most cases had no immediate prospect of showing commercial results, and it was for this reason that it was necessary to carry on such work in the laboratories of our universities and colleges, and in order that this could be done professors and teachers should be paid salaries which would not render it necessary for them to seek other work in order to be able to live. Therefore, he asked that the Government should set aside funds for putting university and similar laboratories in an efficient state and at the same time adequately remunerate those engaged. Speaking with regard to the work of the National Physical Laboratory, Professor Thomson said that the finances of this body were not in a satisfactory state to grant adequate salaries to trained assistants. Indeed, many of the assistants at the National Physical Laboratory had expressed their intention of taking up posts in private establishments at salaries double what they are now receiving.

Sir Maurice Fitzmaurice, speaking on behalf of industrial research, said that as chairman of the Standing Committee on Engineering appointed by the Advisory Council, he must confess that they had received a set-back. Notwithstanding the great enthusiasm of the members and the large amount of work that had been done, it was realised that in order to carry on the work contemplated further funds were essential, and that the assistance of the State must be given. He hoped that the Government would look at the matter in a broad-minded way, at the same time giving consideration to the question of the relative contributions which should be made by the State and industries to the researches which he hoped would be carried out.

Professor H. B. Baker, F.R.S., spoke in the cause of industrial research in chemistry. There were two kinds of chemical research. The first was what might be called *ad hoc* research, *i.e.*, research undertaken with the idea of improving some particular process for the utilisation of some bye-products, but there were also problems which had no direct industrial aim. It was only since the war that there had been a coming together of the academic and manufacturing chemists in this country. If more research could be carried out by collaboration between the manufacturer, the universities, and the college laboratories, an enormous advantage would be done to the whole of the chemical industry in this country.

Lord Crewe, replying to the deputation, said he was able to reply, in his capacity as President of the Council, to a certain extent to what had been advanced by the different speakers. The funds at the disposal of the Council for the purpose of research came under three heads, namely, the provision of money by Parliament, the receipt of moneys from different parts of the Empire for the prosecution of certain researches, and the receipt of money from private benefactors. With regard to the latter he had been told that two gentlemen, brothers, and members of the Institution of Mechanical Engineers, had given a handsome donation to be devoted to the purpose of industrial research, and at the same time had expressed the hope that their example would be followed by others. As to the receipt of money from other parts of the Empire, that, no doubt, would be increased as the activities of the new department became more widely known. Already some researches were in process of organisation, even if they had not actually been begun, which were of practical interest to the overseas dominions. That, however, was a class of work which clearly at the present stage must be regarded as secondary. With regard to the provision of money from public funds, the Government had been impressed by the need of giving further help to research work. As was well known, a certain sum had already been voted, but consideration had been given to how help could be best afforded in this direction to assist the great staple industries of the country by developing systematic research on a large scale. It was quite clear that in a number of cases individual firms would benefit very largely from research work, and it was not reasonable to suppose that the taxpayers of the country should pay the whole amount devoted to such researches, and steps were being taken to bring about close co-operation between leaders of the different great industries in order to arrive at what form public money should be provided for the purpose. The Government Department concerned had given the whole matter consideration, and the conclusion had been come to that any system of granting a definite sum of money each year for the purpose of research would be altogether hopeless, and the Chancellor of the Exchequer, who took a big interest in the subject, proposed to advise the Government to make an exception in this matter, and to devote a very large sum generally estimated to meet the needs in view for a period of the next five years, on a scale which would enable the expenditure to be four or five times as much as had been already spent for the whole purpose of research hitherto. In order, however, to bring about adequate co-operation between the Government and private firms in this matter, the Government desired to see either the creation of new, or the adaptation of existing, trade associations on a large scale, which would be able to assist the provision which any particular industry would be able to make towards this systematic research. Some of these associations, it was hoped, would be specially formed for the purpose, whilst in other cases, where great commercial associations for particular industries already existed, a branch of the association might easily be appointed specially devoted to the subject. It would be necessary that the financial arrangements for research work in these associations should be kept separate from the general finance. In the case of the engineering industries, where there were a great variety of applications, it would probably be found possible to form a series of distinct associations for research purposes, and in that case an individual firm having various activities could select the association to which it would contribute in respect of any particular class of research at any given time. It might be asked what inducement beyond subscribing a portion of the actual amount required the Government was offering to industries embarked in this direction. He had been in communication with the Treasury on the matter, and had been informed that any subscriptions for this purpose would be treated as working expenses for income-tax purposes. In addition to this sum, which was expected to last four or five years, the Government proposed to vote annually for various purposes money, such, for instance, as those cases in which an individual research worker needed a grant in order to enable him to get on with the problem he had in hand. There were already some scientific societies which stood in need from time to time of assistance to enable them to carry on research work, and such assistance would be given where necessary. As to the finances of the National Physical Laboratory, these would be given the most careful consideration by the Advisory Committee, because the value of the work done at Bushy was fully recognised. Closely related to the question of industrial research was technical school training, and the conclusion had been arrived at that the present regulations under which technical schools received public money were apart from University institutions, and were not up-to-date for our modern conditions. It was, therefore, proposed to discuss with the local authorities concerned, certain new draft regulations. Further, the Government had decided that special increases would be made to the estimates of the Board of Education for assisting local authorities managing technical schools. In addition, important arrangements would be made for the training of technical teachers, and for granting of scholarships, in order to carry to the Universities selected industrial students.

Finally, Lord Crewe referred to the work of the Coal Conservation Committee over which Lord Haldane has been presiding. This Committee has been working in close touch with the Advisory Council and the Committee of the Privy



Council, and the Advisory Council and the Coal Committee had agreed upon a series of researches to establish the scientific basis for systematic economy in the use of fuel. The intention was to begin with a chemical survey of the various coal measures of the United Kingdom, to examine and experiment upon the different kinds of coal, and to discover their suitability for different processes, such as cooking and so on.

Below are the official details of the scheme :—

The Government have decided to establish a separate Department of Scientific and Industrial Research for Great Britain and Ireland under the Lord President of the Council, with the President of the Board of Education as Vice-President. They have also decided, subject to the consent of Parliament, to place a large sum of money at the disposal of the new department to be used as a fund for the conduct of research for the benefit of the national industries on a co-operative basis.

The Board of Inland Revenue have decided, with the approval of the Chancellor of the Exchequer, that no objection shall be offered by their Surveyors of Taxes to the allowance, as a working expense, for income-tax purposes, of contributions by traders to industrial associations which may be formed for the sole purpose of scientific research for the benefit of the various trades; and the allowance would be equally applicable as regards traders' contributions specifically earmarked to the sole purpose of the Research Section of an adapted existing association.

In both cases the allowance would be subject to certain conditions, *e.g.*, the association or the research section to be under Government supervision and the trader's contribution to be an out and out payment, made from his trade profits and giving him no proprietary interest in the property of the association, etc.

In order to enable the department to hold the new fund and any other money or property for research purposes, a Royal Charter has been granted to the official members of the Committee of the Privy Council for Scientific and Industrial Research under the title of the "Imperial Trust for the Encouragement of Scientific and Industrial Research." The trust is empowered "to accept, hold and dispose of money or other personal property in furtherance of the objects for which it has been established, including sums voted by Parliament to that end." The trust can take and hold land and can "accept any trusts, whether subject to special conditions or not, in furtherance of the said objects."

A substantial gift has already been made to the trust by two members of the Institution of Mechanical Engineers for the conduct of a research in mechanical engineering to be approved by the department in the hope that this example will be followed by other members of the institution.

Mr. H. Frank Heath, C.B., has been appointed Permanent Secretary of the new department, to whom all correspondence should be addressed until December 31st next at the offices of the Board of Education, Whitehall.

South African Electro-Chemical Industries.—The Board of Trade Department of Commercial Intelligence is in receipt of a copy of a report by a committee of the South African Institute of Electrical Engineers (Inc.) on the possibilities of manufacturing in South Africa, by the aid of electrical power, several products of commercial importance which are necessary for the agricultural and mining industries. These two industries now require annually £2,000,000 worth of fertilisers, cyanide and nitrates. The essential elements for the successful manufacture of these materials, it is claimed, exist in South Africa. Estimates are given in the report for the local manufacture of calcium carbide, and cyanamide and derivatives of cyanamide, etc., together with the present cost of similar imported goods and the cost of the electric power required. The report referred to may be consulted by British firms interested at the offices of the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C.

Diesel Engine Users' Association.—At the November meeting of the Diesel Engine Users' Association several new members were elected, and a long list of consulting engineers, manufacturing firms, and others interested in Diesel engine work, but not qualified for full membership, were accepted as "subscribers" to the association. The president (Mr. Geoffrey Porter) announced that the Committee's reports on "Air Compressor Explosions and Troubles," with their recommendations on the subject, had been finally revised, and would be circulated to the members and subscribers. Mr. George B. Vickers read a paper on "Piston and Small End Lubrication in Diesel Engines."

QUESTIONS AND ANSWERS BY PRACTICAL MEN

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of* 10s. *will be paid for the answer which we consider shows the greatest merit, and* 5s. *for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

QUESTION No. 1,617.

I am in charge of a battery of 33 secondary cells (Premier make). Owing to structural alterations above, sea-water has recently been dripping through the ceiling and into about half the cells. Can any of your readers tell me if this will seriously affect them? At present they all keep up their normal voltage and take the charge and discharge as usual. There is no difference in the appearance of plates or acid, except one cell has a kind of frothing on the top. On taking a sample of this frothing and applying a match, it ignited with an explosion. A choking gas is given off from the cells; would this be chlorine? The drops of water from the ceiling taste slightly of acid; is this possible? What is the chemical action producing these effects? The specific gravity seems to have risen in the cells affected. Why?—"A. E. B."

ARMOUR-CLAD SWITCHGEAR

In his recent address as Chairman of the Newcastle Section of the Institution of Electrical Engineers Mr. J. H. Clothier said that, owing to the pressure of the times, he had found it difficult to settle down to the preparation of an orthodox address up to the Institution's standard. He paid tribute to those men who had anwered the calls from the Army and Navy, but he said that the way in which the majority of those engaged in the manufacturing industry had to fight at the present was to multiply their output and to develop with the future in mind.

As the perfection of output is now so freely acknowledged to be of national interest, he thought he need make no excuse for selecting as a subject one for which credit was due to engineers in this country, viz., "The Development of Armour-clad Switchgear of the 'Draw-out' Type." The fundamental bases for the design were :—(1) The oil-break switch; (2) the iron-clad enclosure of conductors; (3) the "draw-out" principle. Each of these features is of early British origin. For instance, Mr. Clothier illustrated an oil switch designed by Partridge, and used on cable mains in 1892, another by Ferranti, used on power-station switchboards in 1894-5, the use of ironclad pillars for generators by Rayworth a year or so earlier. The "Draw-out" principle or the easy detachment of complete working parts was also initiated on the Ferranti slate cell gear. Then years afterwards, acting upon the advice of the engineers of the North-East Coast Power Companies, these main features were assembled on the gear called the "Ironclad" type, which included the enclosure of busbars run in solid with compound (developed about the same time by Highfield), and the covering of each conductor or limb with armour. Owing to the subsequent introduction of other metals than iron for the casing, for instance, steel for switches and aluminium alloys for use in proximity to conductors carryng very heavy currents, he preferred now to call this gear "Armour-clad."

Mr. Clothier also demonstrated the progress that has been made in the last decade by showing designs prepared in this country by several manufacturers, including Westinghouse,

"ELECTRICAL ENGINEERING" PATENT RECORD

Specifications Published November 30th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

16,053/15. **Feeder Protection.** M. ROSEBOURNE (formerly Rosenbaum) and F. A. COUSE. A distributing system, in which a point in a resistance connecting the bus-bars is connected to earth by a conductor provided with relay devices arranged so that when a fault occurs on one of the feeders or a conductor connected to the bus-bars, the point of connection of the earth conductor is altered so that the currents in the feeders, which are normally equal, will be unbalanced to such a degree that a differential relay connected therewith will open the feeder circuit-breaker.

15,762/15. **Electromagnetic Clutch.** W. LANGDON DAVIES, A. SOAMES, and NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSHE THERMO-TELEPHOON MAATSCHAPPIJ. The clutch, which is intended for dynamo-driving, in certain circumstances, is caused to release when a predetermined limiting load is reached by the action of a coil carrying the load current in opposition to the main actuating coil energised by a constant potential.

16,854/15. **Heavy-current Dynamos.** M. WALKER. These machines are provided with two commutators. The brushes of the same polarity are divided into two parts staggered in relation to each other on both commutators. The forward part of the brush is so connected to the commutating pole winding, or apparatus which controls the excitation of the commutating pole, that the current collected by the forward part strengthens the commutating pole, and in so doing tends to equalise the currents collected from the two commutators.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Electrometallurgy and Electrochemistry: DEUTSCHE GOLD & SILBER-SCHEIDEANSTALT VORM. ROESSLER [Electrolytic production of sodium perborate] 3,099/16 (*102,089*).

Heating and Cooking: A. H. TAYLOR (*H. Burgess*) [Heating apparatus] 425/16 (*102,070*); A. F. BERRY [Radiators] 1,596/16 (*102,077*); M. J. RAILING and J. H. FARTHING [Electric heating apparatus] 2,615/16 (*102,084*); BRITISH WESTINGHOUSE ELECT. & MFG. CO. [Liquid heaters] 9,111/16 (*100,796*).

Ignition: A. E. LAMKIN [Sparking plugs] 10,297/16 (*102,128*).

Incandescent Lamps: BASTIAN [Gas-filled lamps] 11,332/16.

Instruments and Meters: TRENT [Ohmmeters, &c.] 16,112/15.

Switchgear, Fuses, and Fittings: BRITISH THOMSON-HOUSTON CO. (*G.E. Co., U.S.A.*) [Switches] 15,878/15; WELCH [Lamp-holders] 17,302/15; BROWN [Relays] 18,166/15; E. STEIGER [Electric devices for automatically turning lights on and off] 6,031/16 (*100,365*); A. H. SHORT [Combined lamp-holder and lamp-lock] 7,009/16 (*102,111*).

Telephony and Telegraphy: YEWEN [Telephone transmitters] 8,480/16; SEELAU and NEWMAN [Phonographically recording telephonic messages] 16,149/15; H. SMITH [Microphones for telephone relays, &c.] 139/16 (*102,067*).

Traction: WILSON, SHEPHERD, and POWELL & HANMER, LTD. [Lamp-holders and connections for vehicle lighting] 15,985/15 and 15,986/15; W. R. SYKES INTERLOCKING SIGNAL CO., HARPER and SYKES [Railway Signalling] 17,475/15; W. R. SYKES INTERLOCKING SIGNAL CO., W. R. and R. W. TARRANT, 2,915/15 (*102,087*).

Miscellaneous: DRUCQUER [Electrically-driven calculating machines, &c.] 15,842/15; FERY [Electric cells] 15,930/15; H. R. WRIGHT [Electrical means for indicating or transmitting movements] 5,606/16 (*102,104*); BRITISH WESTINGHOUSE ELECT. & MNF. CO. [Vapour electric convertors] 12,160/16 (*101,346*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Ignition: SOC. ANON. ETABLISSEMENTS DE DION BOUTON [H.T. distribution] 13,304/16 (*102,140*).

Incandescent Lamps: A.E.G. [Argon-filled lamps] 14,643/16 (*102,141*).

Switchgear: O. ANDERSON [Control switches for measuring instruments] 15,054/16 (*102,143*).

Telegraphy: SOC. FRANÇAISE RADIO-ELECTRIQUE [Circuit controlling devices] 15,543/16 (*102,148*).

Amendment allowed

5,766/15. **Signalling.** C. W. WOODWARD. Corrections in this specification, which relates to track circuit automatic railway signalling, have been allowed.

Opposition to Grant of Patents

4,862/15. **High-frequency Apparatus.** H. R. RIVERS-MOORE. An appeal has been lodged against the Controller's decision to refuse the grant of a patent on this application. The specification describes a system of producing high frequency currents in which an inductance in parallel with a condenser is periodically short-circuited by a revolving contact-maker.

Application for Restoration of Lapsed Patent

23,979/11. **Candle Lamps.** C. HARVEY. Application has been made by Huntalite, Ltd., for the restoration of this patent, which had been allowed to lapse owing to non-payment of revenue fees. Notice of opposition must be given before January 15th.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: BRITISH THOMSON-HOUSTON CO. (*G. E. Co., U.S.A.*) [Arc-lamp electrodes containing titanium carbide, with the addition of sulphur to prevent deposit adhering to the lamp globe] 18,965/09.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: D. M. EDWARDS and E. A. BROWN [Split conduit fittings] 17,595/04; ASHINGTON COAL CO. and T. MCKIE [Leakage indicator and protective gear for mining installations] 17,161/06.

Incandescent Lamps: BRITISH THOMSON-HOUSTON CO. (*G. E. Co., U.S.A.*) [Carbon filaments squirted with cadmium amalgam binder] 18,487/06, and [Metal filaments squirted with colloidal metallic binder] 18,488/06.

Miscellaneous: S. KRAUSE [Battery hand lamp] 18,864/09.

Siemens, Holmes, Switchgear & Cowans, Erskine Heap, Electrical Apparatus and Reyrolle, and referred also to B.T.-H. designs. All of these had one common purpose, viz., to meet the characteristically British demand for apparatus solid and substantial in its construction. Perhaps more expensive than some other forms, but having the humane feature of affording the maximum protection to life. As there was a similarity of purpose, so there was a similarity in designs, and though standardisation might be too ideal to consider at the moment, he thought it was not an impossibility, particularly for three-phase 440- to 3,000-volt use.

It has been said in a recently published book that Ironclad "Draw-out" gear was "suitable for mining and sub-stations, but with control-board requirements of a central station the arrangement no longer possesses the advantage of simplicity." He did not agree with this statement. In cases where a control board is requisite, the design of the control board presents no more difficulties with armour-clad gear than with any other form of gear: in fact, in some instances the control board had been considerably simplified on account of the use of armour-clad gear.

Dealing with larger switchgear, he thought the near future would decide in favour of the use of armoured principles for all sizes of plant and power stations. He illustrated examples of large power-station switchgear, and said that the chief problem was the necessary strength of the enclosure of actual circuit-breaking parts to withstand the heaviest stresses likely to occur on breaking short-circuit currents. He saw no limitation to the use of armour-clad gear for any size of plant or for any voltage, and there was no difficulties which experience to date had brought to light, which were not equally applicable to other forms of switchgear construction.

War Profits in Germany.—The *Manchester Guardian* states that the A.E.G. of Berlin reports a net profit of £1,360,000 for the financial year just ended against £1,100,000 in the previous twelve months. A dividend of 12 per cent. is being paid on the old capital of £7,750,000 and 6 per cent. on the new capital of £1,500,000 issued during the past year.

INCANDESCENT ELECTRIC LAMP HANDBOOKS

WE have received from the British Thomson-Houston Co., Ltd. (Mazda House, 77 Upper Thames Street, E.C.), a copy of the first of a series of incandescent lamp handbooks they are issuing. This gives a great deal of useful information and data regarding Mazda lamps of both vacuum and half-watt types, suitable for general illumination, train lighting, projector work, &c. A useful glossary of technical terms used in connection with glow lamps is also a special feature, and the handbook gives, in addition, rules and terms for the sale of Mazda lamps to private consumers, trade users, and re-sellers.

All the forms of standard lighting-lamps falling under what is known as Group I. are illustrated to scale, accompanied by the fullest details as to size, type of cap, efficiency, wattage, voltage range, illuminating output in lumens, standard packing, quantities, &c. Diagrams are also included showing full-size illustrations of the various styles of caps fitted to these lamps. This handbook is one of the most complete publications yet issued in connection with incandescent electric lamps, and readers who have not received a copy should not fail to obtain one by writing to the address given above. The data contained should be studied by all who have to do with the sale and installation of metal filament lamps, and this handbook, with its fifty-two pages, forms a notable contribution to the existing literature on the subject.

LOCAL NOTES

Belfast: *The Power Supply Position.*—At the monthly meeting of the Corporation on the 1st inst. the question of the extension of the electrical plant was considered, on a motion arising out of the minutes of the Electrical and Tramways Committee, which recommended extensions of the electric supply in view of the fact that the margin of plant capacity had run down to a dangerous point when so many applications for additional light and power were being made. The Committee now proposed to place the matter in the hands of experts with the object of getting the best possible advice on the matter and also taking whatever steps were necessary to ascertain if the site for the recently proposed new generating station was yet available. It was further decided to obtain the advice of Sir John Snell as to any modifications, if any, he would suggest being made in his report of August, 1914, on the extension question. During the discussion it transpired that recent applications were very nearly refused—so narrow was the margin—and that with the exception of one other town in the United Kingdom Belfast had the lowest reserve of plant. It was decided to confirm the proposals of the Electrical and Tramways Committee in view of the seriousness of the situation. The proposed new generating station may cost anything up to £100,000.

Birmingham: *Electric Supply Charges.*—An increase is to be made in the charges for electric supply. The present increase of 15 per cent. for current supplied for lighting purposes is to be raised to 30 per cent. and the present charges for power, heating and cooking will be further increased, making the total war increase 30 per cent.

Employees' Wages.—The Committee on Production has granted the employees of the electricity and other trading departments of the Corporation an increase of 2s. 6d. per week. The total sum involved is £43,000 a year. The application of the men was for 6s. per week.

Eastbourne: *Electricity Accounts.*—There was a loss of £911 on the working of the electricity undertaking last year, against a profit of £2,228 in the previous year. The main cause of the deficit is the reduced income from private lighting and street lighting.

Manchester: *Trading Departments' Profits.*—A new committee, known as the Trading Profits' Special Committee, has been appointed, consisting of fifteen members of the various trading departments of the Corporation. The special task of this Committee is to investigate the basis upon which the trading departments contribute profits in relief of rates. At present income-tax at the rate of 25 per cent. is charged on the profits of the various trading departments, and it is suggested that one of the objects of the Committee will be to evolve a scheme whereby this income-tax, which amounted to £46,000 last year, can be saved.

Wrexham: *Increased Lighting Charges.*—The Council has decided to increase by 10 per cent. as from January 1st, the charges for electric supply. The effect upon the undertaking of the street lighting regulations is shown by the fact that only 250 units were consumed by public lamps during October, against 17,850 in the corresponding month of 1915.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Sunderland.—The Corporation require a steam turbine, alternator and condensing plant for the Hylton Road Electricity Works. General Manager, December 9th.

Miscellaneous

Salford.—Two electric lifts are required at the infirmary, Hope, Pendleton. (See an advertisement on another page.)

West Ham.—The Guardians require a three months' supply of electrical fittings. Clerk, Union Road, Leytonstone, December 21st.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £167 to £170 (last week, £166 to £169).

A Luminous Paint.—In view of the multitudinous uses to which a reliable luminous paint can be put at a time like the present, it will interest many of our readers to learn that the Fred. Crane Chemical Co., Ltd. (Birmingham) have introduced, and are now prepared to supply a paint which fully meets every requirement. The paint is supplied either in bulk for the use of manufacturers, or in handy bottles at 2s. each for retailing at that figure.

An Australian firm dealing in electrical goods desires to represent United Kingdom manufacturers of such goods, other than wire and cables, telephones, bells, etc., instruments, circuit breakers, accumulators and switchgear. The representation of United Kingdom manufacturers of motor accessories and electrical fittings is desired by an Australian firm. The names and addresses of these enquirers can be had from 73 Basinghall Street, London.

APPOINTMENTS AND PERSONAL NOTES

An application from Mr. L. W. Woodman, borough electrical engineer at Dover, for an increase of salary has been adjourned for a month. The present salary of £425 per annum now received by Mr. Woodman is the same as that paid him in 1904.

An assistant manager and costing clerk are required for a telephone company abroad. (See an advertisement on another page.)

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Edison Swan Electric Co.—An issue of £100,000 7 per cent. participating preference shares is to be made. The ordinary shareholders will have the £2 per share uncalled liability on their shares cancelled in return for each £1 subscribed. The scheme involves the merging of the two classes of debentures into one, the result of which will be that the 4 per cent. debentures will in future be 5 per cent.

Chloride Electrical Storage Co.—An interim dividend of 5 per cent., free of tax, is declared on the ordinary shares.

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SUMMARY

We bring the Institution Roll of Honour, and the lists of promotions, members on active service, &c., up to date (p. 466).

The earthing and leaking indicating arrangements necessary for three interconnected generating stations of unequal size are discussed in our Questions and Answers columns (p. 468).

In his Presidential Address to the Western Local Section of the Institution of Electrical Engineers, Prof. D. Robertson dealt amongst other subjects with the possibilities as regards this country of sources of energy other than coal (p. 469).

An interesting publication on rotary converters is reviewed (p. 470).

Among the subjects of specifications published at the Patent Office last Thursday were metal filament lamps, ohmmeters, and an electrical method of improving boiler efficiency (p. 472).

There seems every likelihood of the new power station at Belfast being proceeded with.—There was a profit of £8,840 at Dublin last year.—A suggestion by the National Electric Construction Co. to purchase the Torquay Electricity Works has been rejected (p. 472).

New plant is required at Worcester and Woolwich (p. 473).

Arrangements for the Week.—*To-day (Thursday), Dec. 14th.*—Institution of Electrical Engineers. "Colonial Telegraphs and Telephones," by R. W. Weightman. 8 p.m.

Saturday, Dec. 16th.—Association of Mining Electrical Engineers, Midland Branch. Midland Hotel, Mansfield. Discussion on the report by Messrs. Wheeler and Thornton on Electric Signalling with Bare Wires. 3.30 p.m.

Tuesday, Dec. 19th.—Engineers Club, Manchester. Debate on "Engineering Education and Research." Opened by A. P. M. Fleming. 7.30 p.m.

1st LONDON ENGINEER VOLUNTEERS

Headquarters, Chester House, Eccleston Place, S.W.
Orders for the Week by Lt.-Col. C. B. Clay, V.D., Commanding.

Officer for the Week.—Platoon Commander C. H. C. Bond.
Next for Duty.—Platoon Commander L. C. Hughes Hallett.
Monday, Dec. 18th.—Technical for Platoon No. 9 at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25 to 8. Lecture on Telephones, 7.30.
Tuesday, Dec. 19th.—School of Arms, 6 to 7. Lecture, 7.15, "Bridging," Coy. Cmdr. E. J. Castell.
Wednesday, Dec. 20th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 1 to 2.
From *Thursday, Dec. 21st*, to *Thursday, Dec. 28th*, inclusive.—Headquarters closed.
Musketry.—For all Companies see Notice at Headquarters.
Note.—Unless otherwise indicated, all drills, etc., will take place at Headquarters.

Memorial to the late Professor S. P. Thompson, D.Sc., F.R.S.—A fund is being raised to purchase the very valuable scientific library of the late Dr. Thompson and to present it to the Institution of Electrical Engineers as a memorial of his life and work, the library to be accessible to the public on the same conditions as the Ronalds Library. The Committee includes the following:—

Sir William Bennett, President of the Illuminating Engineering Society;
Professor C. V. Boys, F.R.S., A.R.S.M., President of the Physical Society of London;
F. J. Cheshire, President of the Optical Society;
Wm. Duddell, F.R.S., Past President of the Institution of Electrical Engineers;
Sir Robert Hadfield, F.R.S., President of the Faraday Society;
Captain C. Thurston Holland, M.R.C.S., President of the Röntgen Society;
J. E. Kingsbury, Treasurer of the Institution of Electrical Engineers;
F. W. Lanchester, President of the Junior Institution of Electrical Engineers;
W. M. Mordey, Past President of the Institution of Electrical Engineers;
J. E. Raworth, President of the Finsbury Old Students' Association;
Sir John Rolleston, Master of the Spectacle Makers' Company;
Sir John Snell, Past President of the Institution of Electrical Engineers;
C. P. Sparks, President of the Institution of Electrical Engineers;
A. Campbell Swinton, F.R.S.; and
Sir J. J. Thomson, President of the Royal Society.

"The Committee wishes to give every member of the Institution of Electrical Engineers an opportunity of joining in this movement, which has already received substantial support, amongst others, from the past and present members of the Council of that institution, to whom a private appeal has been made. Those who wish to subscribe to this fund now or later or to have further information regarding it are requested to communicate with Mr. W. M. Mordey, 82 Victoria Street, London, S.W.

Income Tax.—The Institution of Civil Engineers on June 26th, on behalf of the various professional societies, including the Institution of Electrical Engineers, drew the attention of the Chancellor of the Exchequer to the position of many professional men as regards income tax under present conditions. The following reply has been received from the Treasury:—

In reply to your letter of the 26th June with reference to the position of professional men as regards Income Tax, I am desired by the Chancellor of the Exchequer to say that in the Finance Bill now before Parliament it is proposed to apply to the year 1916-17 the relief originally conferred by Section 13 (I) of the Finance Act, 1914, Session 2.

It is further proposed that where an individual's actual income from all sources for the year 1916-17 falls more than 10 per cent. below the income as assessed or charged, this diminution of income shall, as in 1915-16, entitle him to claim a special relief. For 1916-17, however, in the case of such individuals the relief is to take another form, viz., the repayment of the difference between the amount of tax actually paid or borne for the year, and the amount that would be paid or borne on the simple basis of the actual year's income.

THE INSTITUTION AND THE FORCES

THE following additions to the roll of honour of the Institute of Electrical Engineers are made. Previous lists appeared in our issues for May 4th, p. 160, and July 13th, p. 268 :—

Killed in Action.—Capt. H. G. Baker, Gloucestershire Regt.; 2nd Lieut. H. E. Britton, Royal Field Artillery; 2nd Lieut. H. A. Brown, Scottish Rifles; 2nd Lieut. B. E. Bumpus, Northumberland Fusiliers; Lieut. R. Burleigh, Royal Flying Corps; Pte. R. L. Castle, Royal Warwickshire Regt.; Capt. W. A. Douglas, Royal Scots; 2nd Lieut. C. T. Eaddy, North Staffordshire Regt.; 2nd Lieut. N. D. Edingborough, Middlesex Regt.; Lieut. S. G. Killingback, Royal Engineers; Lieut. H. P. Organ, York and Lancaster Regt.; Lieut. J. H. Palmer, Royal Fusiliers; Pte. T. F. Phillips, Mortar Battery; 2nd Lieut. S. M. Rawson, Royal Fusiliers; 2nd Lieut. D. Reeves-Smith, Royal Engineers; Capt. J. A. Rutherford, Machine Gun Corps; Sergt. R. Scrivener, Royal Fusiliers; 2nd Lieut. C. R. Ward, Royal Engineers; Lieut. C. S. Wolstenholme, Durham Light Infantry; Capt. A. L. Wood, Lancashire Fusiliers.

Killed.—Flight-Lieut. H. A. Bower, Royal Naval Air Service.

Died of Wounds.—Lieut. T. Challoner, M.C., Royal Engineers; 2nd Lieut. C. S. Coombs, Royal West Kent Regt.; 2nd Lieut. G. M. Frieake, Oxford and Bucks Light Infantry; 2nd Lieut. J. S. Gibson, Bedfordshire Regt.; 2nd Lieut. F. R. Hoggett, Royal West Surrey Regt.; 2nd Lieut. H. W. Pink,, Royal Engineers.

The following additional military honours have been awarded. Previous lists appeared in our issues of April 20th, p. 140, Feb. 10th, p. 46, and July 13th, p. 268.

Military Honours Awarded.

Distinguished Service Order.—Bt. Major B. C. Battye, R.E.: "For conspicuous gallantry and ability during a period of active operations. His skill and energy in sending forward reinforcements and ammunition under very difficult circumstances tended much to the success of the operations. He had previously made a personal reconnaissance of great value."—*London Gazette*, July 27th, 1916.; Major R. A. McClymont, R.F.A.: "For several days he cut the enemy's wire, using an observation post which was exposed to heavy shell fire. Later, during an advance, he maintained communication with his battery, and was enabled to cut hostile wire and frequently to bring the fire of his battery to assist our infantry advance and to resist enemy counter-attacks."—*London Gazette*, September 22nd, 1916; Major A. Robertson, R.E.; Capt. H. C. Sparks, M.C., London Regt. "For conspicuous gallantry in action. During an assault on the enemy's trenches he took command when his senior officer was killed, and rallied his men, who were under heavy fire, and had expended nearly all their ammunition. With a handful of men he made a most determined stand, although nearly surrounded, and thus enabled the remainder to withdraw. He was the last to leave."—*London Gazette*, August 25th, 1916.

Military Cross.—2nd Lieut. W. H. C. Coates, R.F.A.: "He took command of his battery with great skill and coolness. His personal courage under very heavy fire set a fine example to his men."—*London Gazette*, November 14th, 1916; Lieut. R. H. Covernton, South African Engineers: "He, with two men, established communications under very heavy fire. He displayed great courage and skill throughout."—*London Gazette*, November 14th, 1916; Capt. J. M. Donaldson, King's Royal Rifle Corps: "For conspicuous gallantry in action. Although wounded he remained with his company, encouraging them on under heavy shell, rifle, and machine-gun fire, until he was hit again and forced to retire."—*London Gazette*, August 25th, 1916; 2nd Lieut. R. E. Keelan, R.E.: "For conspicuous gallantry and good work during operations. He laid out a trench and organised his working party along it under heavy fire in the night, displaying great resource, energy, and coolness. He had previously done similar good work under fire."—*London Gazette*, August 25th, 1916; 2nd Lieut. F. A. Menzies, Indian Infantry: "For conspicuous gallantry in going out, accompanied by one man, to within 100 yards of the enemy's lines and cutting the wires of six land mines. He then brought in his companion, who had been severely wounded. Three days later he was himself severely wounded."—*London Gazette*, July 27th, 1916; Capt. S. M. Mohr, Notts and Derby Regt.: "He showed great skill and determination in constructing a trench under very heavy fire. Later, when his company had suffered many casualties, and were under heavy artillery fire, he carried out his work with great skill."—*London Gazette*, November 14th, 1916.; 2nd Lieut. B. J. Moore, R.F.C.: "For conspicuous gallantry and skill. He has destroyed two enemy kite balloons, one of which was being guarded by an enemy aeroplane. He has repeatedly attacked hostile aircraft, on one occasion attacking a flight of four, all of which he drove down and two of which he followed to 2,000 feet, one being apparently hard hit."—*London Gazette*, July 27th, 1916; Capt. E. H. E. Woodward, Gloucestershire Regt.: "He led his company in the assault with great dash until he was wounded. He displayed great coolness and courage throughout the dy."—*London Gazette*, September 22nd, 1916.

Bar to Military Cross.—Capt. H. R. L. Groom, M.C., Royal Warwickshire Regt.: "He led his company with great dash in the attack, and captured a large number of prisoners. Though wounded early in the day, he carried on with great determination, till the company had captured and secured its objective."—*London Gazette*, October 20th, 1916.

Distinguished Service Cross.—Lieut. T. N. Riley, Divisional Engineers, R.N.D.: "In recognition of his services with the Royal Naval Division in the Gallipoli Peninsula."—*London Gazette*, September 6th, 1916.

Distinguished Conduct Medal.—Sergt.-Major H. M. Kirkby, London Regt.: "For conspicuous gallantry and ability since the commencement of the campaign. During this period his Company had only one officer, and his powers of leadership and devotion to duty were most marked."—*London Gazette*, March 10th, 1916.

Croix de Guerre (avec Palme).—Capt. H. C. Sparks, D.S.O., M.C., London Regt.

Mentioned in Despatches.—Lieut. A. R. Alderson, R.E.; Quartermaster E. A. Barker, York and Lancaster Regt.; Lieut. B. L. Bishop, R.E.; Lieut. C. Bollam, Divisional Engineers, R.N.D.; Sapper J. H. P. Burchett, Divisional Engineers, R.N.D.; Lieut. T., Challoner, M.C., R.E.; Major T. C. Cunningham, R.A.; Lieut. J. G. Deedes, R.E.; Capt. F. I. L. Ditmas, Reserve of Officers; Capt. H. W. Franks, A.S.C.; Capt. R. Grierson, Divisional Engineers, R.N.D.; Major F A. Iles, R.E.; Major J. H. Mousley, D.S.O., R.E.; Warrant Officer G. D. Nelson, R.N.A.S.; Capt. F. O. J. Roose, R.G.A.; Brig.-Gen. A. M. Stuart, C.B., R.E.; Lieut. J. M. Thornton, R.E.

Members on Military Service.

Below is the ninth list of members serving with the Forces. The last list appeared in our issue of July 13th, p. 268.

Members.—Lieut. H. C. Bishop, Welsh Regt.; Pte. A. O. Buckingham, China British Volunteer Corps; Lieut. A. S. Campbell, General List; Lieut. C. Carew-Gibson, R.N.V.R.; 2nd Lieut. J. D. Coales, D.Sc., R.F.C.; 2nd Lieut. L. H. Combe, R.H.A.; Lieut.-Col. Prof. J. D. Cormack, Aircraft Equipment; 2nd Lieut. E. S. Dashwood, R.M.A.; Capt. S. E. Glendenning, R.E.; Lieut. Dr. J. Henderson, R.E.; Lieut. A. S. Herbert, Australian Engineers; Lieut. A. G. Ionides, R.N.V.R.; Lieut. W. D. Kilroy, R.N.V.R.; Commander F. G. Loring, R.N.; Staff Surgeon J. Macintyre, M.B., R.N.V.R.; Lieut.-Col. M. J. P. O'Gorman, C.B., R.F.C.; Capt. T. F. Purves, R.E.; Lieut. L. Pyke, R.N.V.R.; Major S. G. Redman, Northumberland Fusiliers; Lieut. E. S. Saunders, R.N.A.S.; Sergt.-Major B. P. Scattergood, York and Lancaster Regt.; Pte. R. Scott-Atkinson, British North Borneo Volunteer Rifles; Trooper H. B. Stone, Punjab Light Horse; 2nd Lieut. G. S. Thorne, R.F.C.; 2nd Corpl. T. Wadsworth, London Elec. Eng., R.E.

Associate Members.—Lieut. R. D. Archibald, R.G.A.; Lieut. G. H. D. Ascoli, Reserve Cavalry; Lieut. A. M. Atkinson, Kent (Fortress) R.E.; 2nd Lieut. C. S. Atkinson, East Riding (Fortress) R.E.; 2nd Lieut. M. B. Baker, R.E.; Sapper L. C. Baldwin, London Elec. Eng., R.E.; Lieut. S. H. Bill, R.N.V.R.; 2nd Lieut. F. Blair, R.E.; Pte. T. C. Booth, Liverpool Regt.; Sapper H. A. Browett, London Elec. Eng., R.E.; 2nd Lieut. W. S. Burge, Northumbrian Divisional R.E.; Instructor J. Cowie, East Lancashire R.F.A.; Capt. E. E. Craig, A.S.C.; Lieut. T. I. Craig, R.N.V.R.; 2nd Lieut. M. H. Curry, R.E.; Able Seaman F. E. Davies, Anti-aircraft Corps (R.N.V.R.); Lieut. F. H. Davies, A.O.D.; Capt. P. T. Davies, Canadian Militia; Sapper W. H. St. A. Davies, London Elec. Eng., R.E.; Major C. H. Douglas, R.F.C.; Lieut. T. E. Dransfield, R.N.V.R.; Lieut. J. H. Durant, Australian Engineers; Trooper G. H. Eaton, Calcutta Light Horse; Sapper D. M. Eunson, City of Edinburgh (Fortress), R.E.; Pte. T. C. Evans, Manchester Regt.; Lieut. T. K. Evans, South Midland R.F.A.; 2nd Lieut. John Ferguson, R.F.C.; Pte. J. W. Fidoe, Inns of Court O.T.C.; Capt. G. K. Field, R.F.C.; Lieut. P. S. Fox, R.N.V.R.; Air Mechanic J. W. Fraser, R.N.A.S.; Lieut. W. C. H. M. Georgi, Durham (Fortress) R.E.; Sub Lieut. W. T. Golden, R.N.V.R.; Sapper R. A. Golding, Australian Engineers; Captain C. F. Gray, Canadian Militia; Sapper E. B. Gray, London Elec. Eng., R.E.; Cadet H. Green, R.E.; Lieut. H. H. R. Green, R.N.V.R.; Lieut. H. H. Gresswell, A.O.D.; 2nd Lieut. F. T. Hamilton, Tyne Elec. Eng., R.E.; Lieut. C. W. Hill, R.N.V.R.; Capt. C. H. A. Hirtzel, R.F.C.; Eng.-Lieut. J. A. B. Horsley, R.N.V.R.; 2nd Lieut. F. C. Hounsfield, A.S.C.; Lieut. D. C. M. Hume, R.N.V.R.; Sergt. E. Hutchison, Australian Artillery; Capt. A. D. Jaffe, London Regt.; 2nd Lieut. S. Johnson, Australian Pioneers; 2nd Lieut. H. Joseph, R.E.; Lieut. R. E. Keelan, R.E.; Cadet H. W. Kefford, R.A.; 2nd Lieut. E. A. Lambert, R.E.; Lieut. A. H. S. McCallum, R.N.V.R.; J. K. MacDougall, Australian Imperial Force; Chief Petty Officer W. S. Mackrill, R.N.V.R.; Sapper A. S. Markes, London Elec. Eng., R.E.; Staff Sergt. J. W. Mayer, R.E.; 2nd Lieut. A. A. Maytham, R.F.A.; Lieut. F. E. Meade, R.E.; Lieut. F. H. Merritt, R.N.V.R.; 1st Class Air Mechanic W. R. Mickelwright, R.N.A.S.; 2nd Lieut. F. S. Miller, Wessex R.E.; R. D. Moss R.N.A.S.; Lieut. S. R. Mullard, R.N.A.S.; Capt. J. S. Nicholson, Staff; 2nd Class Air Mechanic H. G. S. Peck, R.F.C.; 2nd Lieut. E. S. Perrin, R.F.C.; Major J. S. Pitkeathly, C.V.O., General List; 2nd Lieut. P. S. Pitt, A.S.C.; 2nd Lieut. H. A. Price-Hughes, Glamorgan (Fortress) R.E.;

Lieut. C. G. Rattray, R.N.V.R.; Corporal A. C. Rayment, Australian Pioneers; 2nd Class Air Mechanic S. B. Reid, R.F.C.; Pte. R. L. W. Roberts, R.W.F.; S. R. Roget, A.-A.C. R.N.V.R.); Capt. J. A. Sadd, Staff; Lieut. E. E. Sharp, A.O.Dept.; Capt. R. Sherley-Price, R.E.; Capt. E. A. Short, Staff for R.E. Services; Sapper E. E. Smeeton, London Elec. Eng., R.E.; Lieut. A. C. Smith, A.O.Dept.; 2nd Lieut. D. Smith, R.F.C.; 2nd Lieut. J. N. Stephens, R.F.C.; 2nd Lieut. A. A. Stone, A.S.C.; 2nd Lieut. C. F. Trippe, R.E.; Sapper J. A. Troughton, London Elec. Eng., R.E.; Capt. L. B. Turner, General List; 2nd Lieut. W. B. Turner, R.G.A.; Lieut. M. G. Tweedie, R.E.; 2nd Class Air Mechanic L. N. Vine, R.F.C.; Pte. L. T. Wakeford, British North Borneo Vol. Rifles; Lieut. J. Warren, A.O.Dept.; Lieut. J. K. Wells, R.N.V.R; Lieut. P. Wood, R.N.V.R.

Associates.—E. Brooks, R.G.A.; Sapper C. S. Chaster, London Elec. Eng., R.E.; Sapper S. Evans, London Elec. Eng., R.E.; Lieut. P. M. Hampshire, R.N.V.R.; Lieut. W. H. Hunter, A.S.C.; Major A. M. Keays, Training Reserve Batt.; Sergt. H. M. Millar, N.Z. Engineers; Major G. Phillips, General Staff; Cadet J. H. Reeves, R.G.A.; Lieut. J. H. Rickie, Burma Railway Vol. Corps; Lieut. J. H. Stephens, Middlesex Regt.; 2nd Lieut. W. J. Webber, R.F.C.

Graduates.—Major T. H. Barr, Military Representative for Renfrewshire; Sub-Lieut. H. S. Fellowes, R.N.V.R.; Eng. Room Artificer S. M. Hill, R.N.; Air Mechanic T. W. Howard, R.F.C.; Sapper L. M. Jockel, London Elec. Eng., R.E.; Lance-Corpl. J. H. McClay, A.S.C.; 2nd Lieut. J. Miller, Lowland Divisional R.E.; Sub-Lieut. M. J. H. Molyneux, R.N.A.S.; 2nd Class Air Mechanic J. W. W. Munro, R.F.C.; 2nd Lieut. J. B. Murray, R.E.; Corporal H. Norman, London Elec. Eng., R.E.; 2nd Lieut. E. A. Richards, R.F.C.; Lieut. W. Rintoul, Northern Signal Service, R.E.; 2nd Class Air Mechanic T. C. Schneidau, R.F.C.

Students.—Lieut. A. W. Adams, East Anglian Divisional R.E.; Pte. G. A. Allan, R.W.K. Regt.; 2nd Lieut. L. M. Barlow, R.F.C.; 2nd Lieut. R. D. Binnie, R.M.A.; 2nd Lieut. W. H. Cable, R.E.; Sapper F. A. E. Caspar, R.E.; 2nd Lieut. R. M. Charley, R.F.C.; 2nd Lieut. J. H. Chamley, A.S.C.; Pioneer F. Colburn, R.E.; 2nd Lieut. N. R. De Pomeroy, R.F.C.; 2nd Lieut. W. Dancy, R.G.A.; 2nd Lieut. E. H. Duckworth, London Elec. Eng., R.E.; Sergt. W. V. H. Duff, Australian Infantry; Sapper F. Dunnill, London Elec. Eng., R.E.; Sapper G. H. Elsden, London Elec. Eng., R.E.; Sapper W. Exley, Tyne Elec. Eng., R.E.; Sub-Lieut. D'a. G. Fisher, R.N.V.R.; Cadet R. E. S. Fisher, R.E.; 2nd Class Air Mechanic E. W. Flint, R.F.C.; 2nd Corpl. William Gibson, R.E.; Gunner B. M. Gillett, R.G.A.; Motor Eng. J. H. Goodwin, Friends Ambulance Unit; Lieut. C. L. Hall, R.E.; Lieut. L. J. Hancock, R.E.; H. J. Hindom, R.F.C.; Sapper C. L. G. Hyde, R.E.; 2nd Class Air Mechanic J. F. Lee, R.F.C.; Lieut. H. H. Leys, Lowland R.F.A.; R. E. M. Linay, R.F.C; Able Seaman G. W. McCall, R.N.A.S.; Sub-Lieut. E. L. A. Mathias, R.N.V.R.; Sapper B. M. Murray, London Elec. Eng., R.E.; Sapper J. F. W. Needham, London Elec. Eng., R.E.; 2nd Lieut. V. H. G. Parker, R.F.A.; 2nd Lieut. A. M. Parkinson, R.E.; Lieut. D. H. Robinson, South Staffs Regt.; V. Ross, R.E.; 2nd Lieut. B. Rowe, Manchester Regt.; Air Mechanic R. C. Senior, R.N.A.S.; Sapper J. F. Slingerland, London Elec. Eng., R.E.; Orderly W. K. Smith, British Red Cross; Lieut. H. W. S. Smyth, R.E.; Sapper H. S. Tilson, London Elec. Eng., R.E.; Sapper E. Walker, London Elec. Eng., R.E.; E. A. Warden, Canadian F.A.; Sapper G. G. Wardrop, London Elec. Eng., R.E.; 2nd Lieut. R. J. Webb, Kent (Fortress) R.E.; Pte. S. H. Winkley, Inns of Court O.T.C.; 2nd Lieut. C. F. Wormull, R.F.C.; 2nd Lieut. R. Young, South Lancs. Regt.

Institution Staff.—Pte. H. J. Ashford, A.S.C.; Driver L. W. Clinch, A.S.C.; Sapper J. Corthesy, London Elec. Eng., R.E.; Cadet W. V. Crowther, R.G.A.; 2nd Class Air Mechanic F. Grant, R.F.C.; Sapper F. C. Harris, R.E.; Pte. F. H. W. Hedges, A.V.C.; Pte. S. V. Herring, London Regt; Sergt. H. J. Nunn, H.A.C.; Pte. C. W. Skinner, H.A.C.; Pte. G. Tillott, R.B.

Promotions, Transfers, &c., of Members on Military Service.

Additional promotions are as follows:—

Members.—Capt. C. Barber, R.F.C.; Capt. E. A. Barker, R.E.; Lieut. C. N. M. Hamilton, R.G.A.; Capt. G. Marconi, Italian Navy; Lieut. S. Paterson, R.E.; Capt. A. P. Pyne, Tynemouth R.G.A.; Major H. C. Sparks, D.S.O., M.C., London Regt.; Capt. W. T. Taylor, R.F.C.

Associate Members.—Lieut. C. E. Abell, London Elec. Eng., R.E.; Major F. C. Aldous, M.G.C.; 2nd Lieut. G. C. Allingham, R.E.; 2nd Lieut. J. O. Archer, R.F.C.; 2nd Lieut. A. Ardern, R.E.; Capt. T. C. Baillie, R.G.A.; 2nd Lieut. L. W. Barney, R.F.C.; 2nd Lieut. F. C. Baumann, London Elec. Eng., R.E.; Lieut. H. L. Bazalgette, London Elec. Eng. R.E.; Lieut. F. Birch, R.N.V.R.; Capt C. R. Bland, London Regt.; 2nd Lieut. G. F. Boxall, R.E.; 2nd Lieut. C. C. H. Brazier, Indian Infantry; Capt. J. M. Brewis, Army Ordnance Dept.; 2nd Lieut. W. S. Browne, London Elec. Eng., R.E.; Capt. R. Bruce, R.E.; 2nd Lieut. K. D. Bullpitt, Essex Regt.; Capt. S. W. Carty, A.S.C.; Lieut. E. V. Clark, Australian Engineers; Major W. G. Clarke, R.E.; Lance-Corpl. A. E. Clayton, London Elec. Eng., R.E.; Flight-Lieut. B. C. Clayton R.N.A.S.; Major P. Colbeck, Northumberland Fusiliers; Capt. J. G. Cunliffe, Manchester Regt.; Lieut. L. H. Davies, R.G.A., Pte. A. A. Davis, South African Infantry; Capt. L. H. Dermer, West Riding Divisional R.E.; Lieut. H. Dobell, R.N.V.R.; Capt. J. W. Dodds, A.S.; 2nd Lieut. H. A. Eastman, R.E.; Sergt. E. J. Edgar, Divisional Engineers, R.N.D.; Capt. C. H. W. Edmonds, R.E.; Lieut. E. A. Edwards, R.E.; Lieut. W. G. Edwards, Tyne Elec. Eng., R.E.; 2nd Lieut. R. Francies, London Elec. Eng., R.E.; Capt. H. W. Franks, A.S.C.; Lieut. W. W. E. French, R.E.; 2nd Lieut. R. H. Friend, R.E.; Lieut. P. B. Frost, R.E.; Warrant Electrician M. R. Gardner, R.N.; 2nd Lieut. V. W. Gill, Royal Sussex Regt.; Capt. A. C. Gilling, R.F.C.; 2nd Lieut. F. Goble, London Elec. Eng., R.E.; Lieut. T. R. Graty, R.E.; 2nd Lieut. E. Graves, Indian Army Reserve of Officers; 2nd Lieut C. S. Hann, London Elec. Eng., R.E.; 2nd Lieut. G. Hartley, Lancashire Fusiliers; Flight-Lieut. C. H. Hayward, R.N.A.S.; Lieut. B. Hoyle, R.N.V.R.; Lieut. C. G. Huntley, Tyne Elec. Eng., R.E.; 2nd Lieut. G. Ingram, R.E.; 2nd Lieut. A. L. Johnson, R.F.C.; Lieut. W. G. Johnson, R.E.; Capt. J. G. Jones, Royal Fusiliers; Capt. H. M. Kirkby, Army Ordnance Dept.; 2nd Lieut. B. W. Leak, R.G.A.; Sergt.-Major C. G. Le Feuvre, A.S.C.; 2nd Lieut. B. J. Leggett, Royal Berkshire Regt.; Lieut. R. C. Leslie, Army Cyclist Corps; 2nd Lieut. H. J. Loughlin, R.E.; 2nd Lieut. V. H. M. McMahon, A.S.C.; Lieut. F. H. Mann, R.N.V.R.; Lieut. R. R. G. Mann, R.E.; Capt. S. Mathews, London Elec. Eng., R.E.; Capt. R. C. Milliken, London Elec. Eng., R.E.; Capt. S. E. Monkhouse, Tyne Elec. Eng., R.E.; 2nd Lieut. H. W. Nimmo, London Elec. Eng., R.E.; Capt. J. Parkinson, R.E.; 2nd Lieut. H. H. Pearson, R.E.; Lieut. W. G. T. Pope, R.E.; Lieut. T. Y. Porter, East Lancashire R.E.; Lieut. S. Ransom, R.F.C.; Major T. E. Robertson, R.F.C.; Lieut. G. H Sargent, A.S.C.; Lieut. C. G. Seeley, R.E.; 2nd Lieut. E. W. Sleight, Royal Lancaster Regt.; 2nd Lieut. A. Smellie, R.E.; Lieut. B. H. Smith, R.E.; Capt. A. C. Sparks, R.E.; Capt. C. F. D. Suggate, A.O.D.; Major H. C. Symmes, South African Infantry; Lieut. F. E. M. Thrupp, East Lancashire Divisional R.E.; Capt. F. W. Timmis, R.G.A.; Flight-Com. N. B. Tomlinson, R.N.A.S.; Corpl. A. P. Williams, Australian Engineers; Lieut. R. A. Williams, R.E.; 2nd Lieut. J. W. Wyles, Indian Army Reserve of Officers.

Associates.—Rev. Sergt.-Major T. W. Foinette, A.O.C.; Major R. A. McClymont, R.F.A.; Sub-Lieut. E. A. Nash, R.N.V.R.; Capt. G. R. Rosevere, A.O.D.

Graduates.—Lieut. E. G. Bowers, Northumberland Fusiliers; Lieut. P. Grice, North Staffordshire Regt.; Capt. H. R. L. Groom, M.C., Royal Warwickshire Regt.; 2nd Lieut. T. J. Hornblower, R.E.; Lieut. S. A. Laird, R.F.C.; Capt. A. McPherson, H.L.I.; Capt. L. T. G. Mansel, R.F.C.; Lieut. C. E. Monks, North Staffordshire Regt.; Capt. F. L. Otter, London Regt.; 2nd Lieut. C. W. Saunders, New Zealand Engineers; Lieut. C. Vandermin, R.E.

Students.—Capt. J. R. Abbott, Tyne Elec. Eng., R.E.; 2nd Lieut. E. C. Albrecht, R.A.; Sapper G. B. Alvey, R.E.; Lieut. S. D. Anderson, R.E.; Sub-Lieut. S. J. W. Baldwin, R.N.A.S.; Capt. B. L. Bishop, Royal Anglesey R.E.; 2nd Lieut. H. P. Bramwell, R.F.C.; Capt C. L. Bunt, Duke of Cornwall's Light Infantry; Lieut E. L. Chadwick, Royal Warwickshire Regt.; 2nd Lieut. D. S. Charles, R.H.A.; 2nd Lieut. E. W. Cosserat, R.E.; 2nd Lieut. E. L. Damant, R.E.; Lance-Corpl. A. R. Dawes, London. Elec. Eng., R.E.; Lieut. C. Derry, A.S.C.; 2nd Lieut. E. T. Driver, R.F.C.; Flight-Lieut. D. Gill, R.N.A.S.; Capt. H. J. Gwyther, Manchester Regt.; Lieut. L. V. Hart, R.E.; 2nd Lieut. H. Headsward, R.E.; 2nd Lieut. C. J. Hews, London and Tyne Elec. and Mech. Co., R.E.; Lieut. A. Howarth, West Yorkshire Regt.; Lieut. H. Hudson, Canadian A.S.C.; Lieut. P. R. Hughes, R.F.A.; Lieut. Forbes Jackson, R.N.V.R.; Lieut. J. W. Jones, East Lancashire Divisional R.E.; 2nd Lieut. C. S. Knight, London Elec. Eng., R.E.; Sergt. B. H. Leeson, Divisional Engineers, R.N.D.; Lieut. A. H. Leeves, R.E.; Lieut. G. A. B. Leishman, R.F.A.; 2nd Lieut. A. Lisle, R.E.; Lieut. L. A. McDougald, R.F.C.; Lieut. A. W. R. Macpherson, R.E.; Lieut. G. E. Martin, R.G.A.; Capt. R. Marx, R.F.A.; Lieut. James Mould, R.G.A.; Lieut. J. J. Page, R.F.A.; 2nd Lieut. L. H. Peter, R.F.C.; 2nd Lieut. A. H. Pullan, R.E.; 2nd Lieut. W. A. Reeves, R.F.C.; Lance-Corpl. W. Richardson, Manchester Regt.; Lieut. H. Riley, R.E.; Lieut. H. S. Ripley, Tyne Elec. Eng., R.E.; Lieut. G. Ross-Bain, Manchester Regt.; Lieut. E. J. Shuter, R.M.; Lieut. N. Sizer. R.E.; Capt. L. C. R. Smith, Royal West Kent Regt.; Lieut. W. W. Stainer, R.F.C.; 2nd Lieut. C. A. Stephens, Tyne Elec. Eng., R.E.; Major D. C. Stern, Royal West Kent Regt.; 2nd Lieut. T. C. Turton, Liverpool Regt.; Flight-Lieut. H. C. Vereker, R.N.A.S.; 2nd Lieut. C. S. Williams, R.E.; Capt. J. B. Windle, Lancashire and Cheshire R.G.A.; 2nd Lieut. L. S. Wooler, R.A.

Tramways and Light Railways Association.—The Government having taken over the greater part of Caxton House, the Tramways and Light Railways Association and the Incorporated Association of Electric Power Companies have removed to Sanctuary House, 33 Tothill Street, Westminster (facing Caxton House).

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

Questions : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

ANSWERS TO No. 1,516.

It is proposed to link up a 2,000 kw. and a 5,000 kw. station to a 20,000 kw. station, the supply of each station being 440 volt, 3-wire. The two smaller stations are supplied from rotary converters, whereas the large station has ordinary steam sets with separate balancers. The following earthing device is installed at the large station :—Normally the neutral is direct connected to earth, but when a fault occurs a solenoid in the neutral circuit operates and inserts a resistance sufficient to limit the current to 20 amperes.

(1) In view of B. of T. rules should not resistance be modified to allow 40 amps. to flow?

(2) Leakage indicators only are installed at each small station. Should, in addition, earthing arrangements be provided similar in action to that at the large station, but of 4a and 10a capacities respectively, or does this infringe B. of T. rules?

(3) As under certain conditions each small station will be working isolated, *i.e.*, supplying its own particular feeders, does not this necessitate the earthing arrangements quoted for each station? If so, would it be necessary to interrupt same when linked with main station?

(4) If the main station were direct connected to earth without the intervention of resistance, would the case be altered in any way? I am told that circulating currents might arise, but I fail to see why, since both earthing positions are also *supply* positions. Please explain this, and say if any damage is likely to occur by earthing both positions.

(5) Would any detrimental effect arise from these "circulating currents" if the station had been three-phase, 500 volts alternating, with neutrals earthed?—["B. of T."]

The first award (10s.) is made to "Y.Z." for the following reply :—

The Board of Trade requirements referred to here are, essentially : (1) that the earth connection of the middle wire should be made *at one point only* for the whole of a system which is electrically interconnected; a second earth connection should be introduced only when there is an electrical break in the system, as between the two sides of a transformer, or in any other similar case, and (2) that a continuous record is to be kept of the leakage current from the middle wire, which must not exceed one-thousandth of the maximum current of the system without steps being taken to make good the defect. In passing, it may be pointed out that the indications of an ammeter in series with the middle wire earth connection are due to the difference between the positive and negative leakage currents at any time. Should a fault occur on each outer main, of the same resistance on each side at the same time, a current would flow from one fault to the other, and as the two fault resistances are equal, the potential of the earth connection on each outer would be half way between that of the outers, or just equal to that of the purposely earthed middle wire. Thus no current would flow in the earth-recording ammeter, which is really just like any other middle wire ammeter on the system, showing the out of balance current only for the particular circuit it is connected to, which is, in this case, the earth and leakage circuit. Now take the parts of the question in the order in which they are numbered.

(1) The value of the resistance is a matter of convenience. The rules quoted give the maximum allowable leakage from the middle wire, and if the resistance is such as to limit the current, when it is put into the circuit by the solenoid, to something less than the maximum, it does not really matter. The main thing is that the solenoid should not operate at too low a current, and so run the risk of tripping at all small faults that occur. It therefore might be rearranged to trip on 40 amperes, 45 amperes being about the maximum allowed, since the current for 20,000 kw. at 440 volts is 45,000 amperes. The object of the resistance is to prevent, when it is inserted, a dangerous rise of voltage on one side of the system in the case of a fault of low resistance occurring on the other side. Should a "dead earth" occur, and the middle wire remain dead earthed, the potential of the earthed outer tries to become zero, while the potential difference between the other outer and the middle wire will rise to nearly, or quite, the normal voltage between outers. If a resistance is inserted in series with the fault, limiting the current to a comparatively low value, the potential of all three wires is pushed up or down by the same amount, and the distribution voltage remains quite normal, except for a momentary kick when the fault occurs and the solenoid is acting.

(2) In view of the rule about earthing at one point only, the middle wires of the small stations should not be earthed when running interlinked with the large station. The three systems form one large system, and there is no more point in having three earth points on the whole system than there would be in having three earth points in any one of the three interlinked systems, if run separately.

(3) If any one of the stations is running isolated from the others, with no connection whatever to the linked-up system, it then becomes necessary, under the rules, to provide an earth connection for that station, as it has become a distinct system of itself. Therefore each station must have its own earthing arrangements, for use when isolated; but they must be interrupted on the smaller stations when linked with the main station, as suggested, so as to comply with the rules again, as all three together now form only one distinct system. The capacity of the earth connections would be, as suggested, proportional to the maximum output of the respective stations.

(4) The first sentence is not very clear. The main station is, normally, "connected to earth without the intervention of resistance," and the resistance is cut in only when an excessive fault occurs. It is not safe to work without the intervention of resistance in any case, for, as has already been explained, dangerous alterations of voltage on the two sides of the system may take place if the middle wire remains definitely and completely earthed when a bad fault occurs on the outers. This means the suggestion cannot be carried out at all with safety. The question of circulating currents is a very complicated one, and can only really be investigated when a full knowledge of the distribution points is obtained. But if the supply stations linked up are some distance apart, and especially if each has its own balancing arrangements, it is quite possible to conceive of circumstances where equalising currents might be compelled to flow between the various stations, owing to the voltages on the two sides being thrown out of balance by the distribution of load at any moment. The two earthed points are each at zero potential, no doubt, but if the potential of the two distinct middle wires is not the same at all times, say if one is slightly above zero at some point, tending to make current flow into the earth connection, and the other is slightly below zero at some point, tending to draw current out of the earth connection, then current will flow from one earth connection to the other; and there is nothing inherently improbable in the suggestion made—it is, on the other hand, a condition of constant occurrence in such a split-up system. If, therefore, both positions are earthed, the two earths act as an interconnection between the stations, and the recording ammeters which are specified to be in the earth circuits will indicate this circulating or equalising current superposed on whatever may be flowing to or from earth as a consequence of faults. Thus to earth both points makes it really impossible to tell from the earth recorders what is going on as regards leakage at all, and, as the leakage indications are hidden away behind something else which has no necessary connection with leakage conditions at all, damage may occur simply because the station engineer has no means of telling what is happening, and so will be living in a fool's paradise! By far the best thing to do is to connect the middle wires of the three stations together by means of definite copper conductors, when running interlinked, and let the balancing be done all at one point in the main station under these circumstances. This will be possible, no doubt, as there are already balancing arrangements good enough for a 20,000-kw. station, and they probably have enough margin to take on the extra out of balance due to the 7,000-kw. additional stations while running interlinked. When running isolated, the middle wires would be disconnected just as the outers are, and each station would balance for itself. This scheme allows any circulating currents which are set up to flow in complete copper circuits, and avoids all interference with the earth arrangements and indications. Only one earthing point would then be used, in accordance with the rules, when running interlinked, though each station would, as before, have its own earthing point when isolated. The Board of Trade rules could be exactly complied

with in every case, and everything would be kept easily and simply in order.

(5) Earthing arrangements on a four-wire three-phase system are fairly well analogous to those for a three-wire continuous current system, and practically the same remarks apply as have already been made. If the middle wire is not made continuous, circulating currents will occur, as has been described above, when the system is purbalanced, and will flow through the various earth points, should there be more than one such point, just as before, in order to use up differences of potential between points on the middle wire. The only difference is that the earth currents will be alternating instead of continuous, and while the electrolytic and other disturbances due to the former may be less than those due to the latter, they are, at the best, undesirable. As they can be easily avoided by taking the steps indicated, it may be said that there is no advantage in this respect as between continuous current and alternating current supplies.

The whole subject of earthing on a large system is a difficult and complex one, and contains problems by no means easy of solution. But the Board of Trade rules form a good compromise between many possibilities, and have not been put in force without full consideration, one may be sure. It is clear, therefore, that the safe course, besides being the compulsory course, is to follow these rules, and arrange the system so that they comply strictly with them.

The second award (5s.) is given to "C. A. S.," who writes as follows:—

It is not quite clear from the question as put by "B. of T." as to the method of linking-up proposed between the 20,000-kw., 5,000-kw., and 2,000-kw. stations. From the wording of the question, however, it would appear that the distributing systems are to be interconnected, and the following reply is based on this assumption. Before proceeding, it will be well to set out here the section of the Board of Trade Regulations concerning the matter. Paragraph 34 reads as follows:—

"Connection of Earth of a Three-wire System.—Where the pressure of a supply between the adjacent conductors of a three-wire system of mains exceeds 125 volts, the intermediate conductor shall be connected with earth in accordance with the following conditions:

"(a) The connection with earth of the intermediate conductor shall be made at one point only on each distinct circuit, namely, at the generating station, sub-station, or transformer, and the insulation of the circuit shall be efficiently maintained at all other points.

"(b) The current from the intermediate conductor to earth shall be continuously recorded, and if at any time it exceed one-thousandth part of the maximum supply current, steps shall be immediately taken to improve the insulation of the system."

1. In view of paragraph (b) above, 20 amps. would appear to be a small limit to set for the earth current of a station of 20,000-kw. capacity. Forty-nine amps would represent 1/1,000 of maximum current capacity of the station, but presumably the actual maximum supply current would not exceed 40,000 amps. Therefore 40 amps., as suggested by "B. of T.," would be a suitable limit to set.

2 and 3. Earthing arrangements similar to that installed at the large stations should be provided at the small stations to comply with the Board of Trade Regulations, and the current-limiting resistance should be such as to permit of 1/1,000 of the maximum supply current passing when either of the outers is connected direct to earth. For the 5,000-kw. station 10 amps. should be suitable, and for the 2,000-kw. station 4 amps. The earth connection at the two small stations should be broken when they are linked to the large station. The Board of Trade Regulations distinctly require that connection to earth should be made at one point only on each distinct system. If the system is earthed at more than one point complications are almost sure to arise, and it is practically impossible to determine the value of leakage currents at any one moment, as the potential differences will be varying owing to the varying fall in pressure between stations and the point where the fault has developed. If the middle wire at 20,000-kw. stations is solidly earthed without intervention of resistance or any current-limiting device, a heavy short-circuit would result whenever either outer wire developed a fault. And with a fault on one side only the resulting out-of-balance current would have very serious results.

4. There can be no interchange of current between the two small stations and the large one due to earth leakages, except in so far as the fall in supply pressure may affect the division of load.

5. The same remarks would apply if the supply were three-phase 500 volts A.C. It is even more important to observe the single point of connection to earth with such a system, as further complications might arise with earth connections at each station, due to interference with phase, occasioned by interchange of earth current.

If, however, the two small stations are to be supplied with current from the 20,000-kw. station and the distributing net-works of mains is to be kept separate, then independent earthing arrangements should be made as mentioned in the first part of paragraphs 2 and 3 above

NATURAL SOURCES OF ENERGY

In his Presidential Address to the Western Local Section of the Institution of Electrical Engineers, Prof. D. Robertson referred, amongst other subjects, to the problem of the supply of energy for our country's industrial purposes in the future, when our coal output diminishes. Our annual consumption of coal, he said, is about 200 million tons per annum. Since the energy of one ton of coal is almost exactly one kilowatt-year, we are drawing on our energy capital at the rate of about 200 million kilowatts. We have, he continued, other sources of energy of which we are aware, and possibly many others still unknown. The energy of disintegration of the atoms is enormous; when this is brought under our control we shall have an ample supply for a few ages more. Another large store of energy, mainly derived from the kinetic energy of rotation of the earth, is made available to us through the tides. The Bristol Channel is by far the most favourable place in this country for the large-scale utilisation of the tides, and the Firth of Clyde stands next. We shall not be far out if we take 10,000 kw. per square mile as applicable to the first and 500 kw. to the second of these areas. A dam across the Bristol Channel from Brean Down to Lavernock Point, taking the Flat Holm on the way, would be under eight miles in length. It would enclose well over 100 square miles of water, and would give, say, a million kilowatts. One built across below Ilfracombe would be nearly 30 miles long, would enclose quite ten times as much, and might be expected to give us about 10 million kilowatts. The only possible place for a dam across the Firth of Clyde is the shallow bar somewhere near the Girvan-Kintyre line. It would enclose much about the same area as the lower Channel one; but owing to the much smaller tides it would probably give us no more than half a million kilowatts. We have, of course, other estuaries which could all be made to contribute their quota, but when all are harnessed I think we shall still be very far short of the equivalent of our present consumption of coal. We may conclude that the tides will never do more than replace a quite small part of our coal consumption.

He did not hold out much hope as to the practicability of the direct use of solar radiation in this climate, although it was practicable on a small scale in tropical countries. Nor was our land particularly well favoured as regards water-power. The difficulties with regard to utilising the power of the wind lay not only in the uncertainties of the winds but in the enormous size which a large-power windmill would have.

The last form of storage which he considered was chemical energy, to which class indeed our coal itself belongs. Failing other means, he continued, we must grow our fuel. I therefore offer to our agriculturists the problem of producing a plant having a high calorific value, which shall utilise as high a proportion as possible of the energy falling on the areas devoted to its cultivation, and which shall be suitable for use as fuel, either directly or by distilling alcohol or other spirit from it. At the same time I ask our electro-chemists to find a method of taking up that energy electrically from the plant, or its products, without first converting it into heat, so as to avoid the large thermo-dynamic losses inherent in the heat engine. Or better still, I ask our chemists to devise some reaction which will occur with the absorption of energy under the action of sunlight, and which can be reversed, under control, with the return of that energy in the electrical form. In short, give us a storage battery which is charged by submitting the active materials to sunlight, and which is discharged in the ordinary way.

Institution Committees.—The December issue of the *Journal of the Institution of Electrical Engineers* gives the list of committees appointed for the year 1916-17. They are as follows:—Electricity Supply Committee; Library and Museum Committee; Research Committee, with sub-committees dealing with buried cables, current densities, insulating materials, composite materials, fibrous materials, ebonite and mica, porcelain, insulating oils, magnetic steels and rubber. In addition, there are Wiring Rules Committee; Shop Electrical Equipment Committee; *Science Abstracts* Committee; and section committees on electric traction, electricity in mines, electro-chemistry and electro-metallurgy, lighting and power, telegraphs and telephones.

Royal Society of Arts.—The juvenile lectures will be delivered by Mr. A. A. Campbell Swinton, F.R.S. He has selected "Electricity and Its Applications" as his subject. The lectures, which will be fully illustrated with experiments, will be given on Wednesdays, January 3rd and 10th, at 3 p.m.

The Institution of Electrical Engineers.—The Council have elected Professor G. Carey Foster, F.R.S., Past-President, to be an Honorary Member of the Institution.

ROTARY CONVERTERS

A FINELY illustrated descriptive list from the British Thomson-Houston Co., Ltd. (Rugby) gives a quantity of interesting information on the firm's most recent practice in the design and use of rotary coverters, throwing light incidentally upon a number of extensions in the utility of those machines which have been developed by the company's engineers. The voltage and current ratios of single, two, three and six-phase converters is explained with the aid of very clearly arranged diagrams, and the subjects of armature heating, commutation efficiency, overload capacity, and power factor, are equally clearly dealt with.

Perhaps the most interesting section is that on the various methods of obtaining and controlling variation in voltage ratio. There are four principal methods by which a variable D.C. voltage with constant A.C. voltage, or *vice versâ*, can be obtained. By the reactance control method, in order to vary the D.C. voltage, the slip-ring voltage is varied, even though the applied voltage at the high tension terminals of the transformer remains constant. This control is effected by the introduction of reactance in the transformer supplying the rotary converter, or by means of a separate external reactance. The percentage reactance installed will depend on the conditions under which the rotary converter has to operate, and can be fixed to suit the case under consideration. The reactance method of control is the cheapest and simplest and is generally installed for conditions of service which do not require more than 10 per cent. to 15 per cent. voltage variation, and where independent control of the power factor is not necessary. It is not advisable to call for larger voltage ranges than are actually required, as the cost of this method of control may be thereby increased.

The booster control method of varying the D.C. voltage consists of inserting an A.C. booster between the slip-rings and armature of the converter. The A.C. booster increases or decreases the A.C. voltage applied to the rotary armature, and so raises or lowers the D.C. voltage. With booster control the power factor is independent of the load and voltage, and consequently unity power factor can be obtained, or, if necessary, leading current can be drawn under any condition of load and voltage. Machines with this control have been constructed for all capacities and frequencies and are installed where the voltage range required is larger than 10 per cent. to 15 per cent., or where independent control of the power factor is required at all loads and voltages. So long as rotary converters were constructed without commutating poles, or were of liberal design with commutating poles, the booster converter formed a compact, cheap, reliable and efficient type of converting apparatus. With the introduction of commutating poles, however, largely increased outputs have been obtained from a given size of machine, and it has been found in such cases that if the booster be used to vary the voltage over wide limits on full load, the commutation has been seriously affected. To overcome this difficulty, diverters have been arranged so as to be connected across the commutating poles as the D.C. voltage is raised, and in cases where the conditions are such that a flash over is likely to occur inductive diverters are sometimes used.

In the induction regulator system of control which represents one of the latest developments, the D.C. voltage is varied by inserting an induction regulator between the transformer and the rotary slip-rings. The regulator increases or deceases the A.C. voltage applied to the rotary armature, and so raises or lowers the D.C. voltage. Similarly to booster control the power factor is independent of load and voltage. This method of control is very similar in arrangement to booster control, and will perform exactly the same functions with, however, the important advantage that the factors which control the commutating conditions of the rotary are independent of the amount of voltage variation. Machines, accordingly, can be supplied of the largest output for a given size, without diverters or auxiliary windings on the commutating poles, and are capable of 30 per cent. voltage variation, and more should occasion arise. Induction regulator controlled rotary converters are often installed for correcting a low power factor, the machines being arranged for operating on 90 per cent. leading power factor at full load at any voltage.

There are two methods of split pole control, employing respectively a three-part pole and a two-part pole. The first method has not been used commercially to any extent on account of certain disadvantages inherent to the design. The second method was patented by the British Thomson-Houston Co. to overcome the difficulties of the three-part pole. This method of control up to the present has only been developed for 25-cycle work, and is suitable for a D.C. voltage range of 25 per cent. with constant A.C. voltage; or with constant D.C. voltage, a range of 25 per cent. on the A.C. side. With this method of control the main poles of the rotary are divided into two portions, the regulating pole and the main pole proper. The main poles are excited similarly to those of the ordinary converter, whereas the regulating poles are arranged so that they can be excited either in the same direction as the main poles or in the opposite direction. The D.C. voltage between the positive and negative brushes is proportional to the algebraic sum of the flux produced by the regulating pole, and that of the main pole. The A.C. voltage between the slip-rings is not proportional to the algebraic sum of the fluxes, because they are placed at nearly 90 electrical degrees; but it is equal to the vector sum of the A.C. EMFs produced by the two fluxes. This method of control is most suitable for small capacity 25-cycle machines, of which large numbers have been built.

Four methods are employed for starting of B.T.H. rotary converters :—A.C. starting by means of taps on transformers; induction motor starting requiring separate synchronising; induction motor starting, self-synchronising, and D.C. starting in the self-synchronising induction motor method

This method of starting is similar to that last described, with the exception the induction motor stator windings are connected in series with the converter armature at starting. The induction motor starts the converter and brings it up to synchronous speed. At this point the motor acts as a synchronising reactance, and allows the converter to synchronise automatically with the supply through the stator windings of the motor. As soon as the converter has synchronised, the induction motor stator windings can be short-circuited and the converter is then ready for paralleling on the D.C. busbars. The development of this method of starting entailed some minor difficulties—especially when starting machines with a small number of poles—but these have been overcome. As a result, any size of machine can now be started without sparking of commutator or reversal of polarity, and be ready for paralleling on the D.C. bus-bars inside one minute without taking more than 35 per cent. of full load current from the high tension mains.

Full illustrated constructive particulars are given in this interesting publication, including such special appliances as the automatic speed limiting service and the end play arrangement to avoid the commutator wearing in grooves. Rotary converters have been built of practically all capacities up to 1,500 kw., and the British Thomson-Houston Company is prepared to build machines of any capacity up to 3,000 kw., for any voltage up to 2,000 volts for 25 cycle work, and up to 1,000 volts for 50 cycle work.

The Range of Electric Searchlight Projectors.—Messrs. Constable & Co. will shortly publish "The Range of Electric Searchlight Projectors," by H. Jean Rey, in order to meet the urgent demand for trustworthy information concerning the theory and practical application of searchlight projectors, their range and resultant illumination. The whole subject is exhaustively dealt with, and embodies records of the author's original investigations and tests carried out in various parts of the world under actual working conditions. Many of the tests and data have been obtained on the Continent during the Great War, thereby considerably enhancing the value of this up-to-date work. A considerable number of problems are involved in obtaining the correct determination of a beam of light projected on to a certain object and illuminated at a specified intensity. Detailed particulars are given relating to the calculation and practical observation of projector ranges when illuminating cavalry and infantry on the march, also lines of trenches, fortresses, high buildings, warships and aircraft, &c. Numerous graphic diagrams clearly show the resultant range of a projector with different values of atmospheric transparency and intensity of illumination, as well as data relating to the area of the arc crater and the carbon diameters for a given size of projector.

A Scottish Engineering Association.—On August 5th a meeting of representatives of the Scottish iron, steel, engineering, shipbuilding, and allied industries was held at Glasgow, under the Chairmanship of the Lord Provost, following on a conference of British industrial and commercial associations, which was addressed by Mr. Hughes, the Prime Minister of Australia, during his visit to Glasgow in April. About 300 forms were represented at the conference in August, and a report of the Preliminary Committee which was then appointed has now been published. The programme outlined by this Committee is very much on the lines of that of the Federation of British Industries, to which we have frequently referred.

REVOLVING SHADE

About a year ago the British Thomson-Houston Co., Ltd., introduced an ingenious advertising novelty in the form of a revolving shade. This was intended for use with table, desk, and other fittings, in which the lamp-holder is in an upright position. When the lamp was switched on the shade rotated owing to an upward current of air heated by the lamp impinging upon a fan disc attached to the upper part of the coned shade and pivoted upon the tip of the lamp. This device could not, of course, be used with pendant lights, but the Company has now produced an adaptation of the design that permits of its attachment to plain pendants.

From the accompanying illustrations it will be seen how the revolving shade is fixed and how it appears when in position.

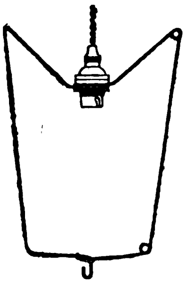

Fig. 1.—Wire Frame, First Position.

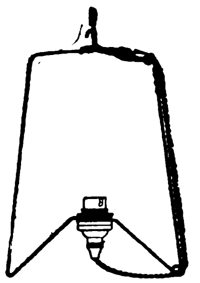

Fig. 2.—Wire Frame Reversed, Ready to Receive Lamp and Shade.

Any existing shade having been removed from a lamp-holder hanging from ordinary flexible cord, it is replaced by a specially designed wire frame, which is held in place by the shade carrier ring. When the frame has been attached, it is turned upside down and the flexible wire threaded through the hook at the apex of the coned frame and the two loops that are formed at the top and bottom of one side. The frame will then hang vertically, with the holder in an upright position. The ends of the curved shade of stout coloured paper are then brought together, projecting tabs at one end being inserted into corresponding slots in the other, the tabs being so slit that they hold the shade firmly in the form of a cone. A cardboard disc with metal centre to fit over the lamp tip is stamped with a number of sectors, and these must be bent upwards so as to form fan blades, the disc being then inserted near the top of

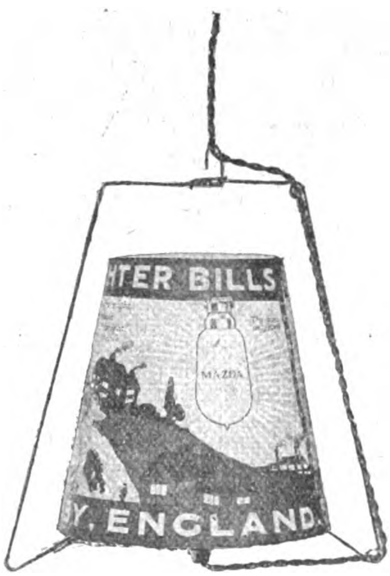

Fig. 3.—Mazda Revolving Shade Complete.

the shade, being held by three tongues, which project into corresponding slots in the shade. The complete shade is then placed on the lamp tip, so that it is free to rotate within the wire frame. When the lamp is switched on, it illuminates the coloured shade, which immediately commences to revolve. If the adapted pendant be placed in a sunny position its shade will rotate during the hours of sunlight without the lamp being lighted. The rapidity with which the shade revolves depends upon the velocity of the heated air current. The greater the wattage absorbed by the lamp the greater is the speed attained.

Readers in the Trade who have not received one of these revolving shades can obtain same upon application to the Publicity Department, The British Thomson-Houston Co., Ltd. (Mazda House, 77 Upper Thames Street, E.C.), each shade being packed in a cardboard box suitable for sending through the post.

LEADING-IN BUSHES

Leading-in bushes are employed for a variety of purposes in electrical plant. In some instances a bush of fairly large diameter, it may either be plain or screwed, is frequently called for, while in connection with motors and dynamos a rather different type is demanded, being of smaller diameter, but of much greater length in order to carry the cables clear of the machine shell. These bushes have in the past been made of rubber, micanite, and wood, while moulded insulation has little been resorted to, despite its obvious claims. Users of these classes of bushes will probably find an extensive range of plain and screwed bushes manufactured by the General Electric Co., Ltd. (67 Queen Victoria Street, London), in their Insulation Department, Witton, Birmingham, of utility to them in these directions. Capable of manufacture in large quantities, with great rapidity and cheapness, they can be used to replace bushes made of other materials. Their accuracy of moulding and neat appearance give them fuller claims to consideration. Samples of one pattern of leading-in tube are shown in the illustration, and are but typical of the hundreds of patterns manufactured at Witton. The company will be glad to quote for their standard bushes or special patterns in any grade of insulation, including Bakelite, to suit the user's requirements. These bushes are also made both plain and screwed, with external and internal threads, in great variety.

Leading-in Bushes of "Witton" Moulded Insulating Material.

HEATING AND COOKING APPARATUS

A very neat little abridged list of electric heating and cooking apparatus from the Bastian Electric Co., Ltd. (185, Wardour Street, W.), contains particulars of a selection of the various lines of goods of which the firm are best able to give good delivery in the present circumstances. A particularly good system of numbering has been adopted, whereby the ordering of any particular voltage or type of glower is simplified. In the case of replacements, the customer merely has to compare with the catalogue number the voltage stamped on the terminals of the glowers in his heater.

The articles in the list comprise a selection of quartzalite heaters and glowers of the latest styles, several forms of the well-known "Pygmy" and "Pyro-ring" heaters, and the larger Pyro-stove, which provides a convenient hot-plate, on which, with a minimum current consumption, three or more saucepans, stewpans or kettles can be maintained at boiling temperature simultaneously.

USEFUL CHRISTMAS PRESENTS

Under the title of "Domestic Helps," the British Westinghouse Electric and Manufacturing Co. (Trafford Park, Manchester) have issued a Christmas gift catalogue containing excellent suggestions for gifts of a truly utilitarian nature. The selection comprises a considerable range of electric heating and cooking apparatus, including various items that we have illustrated from time to time. A particularly suitable gift just now is a neat chafing dish set, and the larger cooking appliances include boiling plates, grillers, and complete stoves. Irons, kettles, and self-contained apparatus, useful all over the house, form an important feature, and attention should also be drawn to the special series of stoveware, heating and cooking utensils, ranging from shaving pots to large casserole dishes. Small motors for domestic purposes, pans, vacuum cleaners, and hair dryers are also represented, and several pages are devoted to electric "fires" of the hot bar type in a great variety of designs and finishes. A few table lamps are also illustrated, and particulars of the all-important Westinghouse drawn-wire British-made incandescent lamps are not omitted.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published December 7th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

11,332/15. **Incandescent Lamps.** C. O. BASTIAN. A method of avoiding the necessity for prolonged exhaustion of metal filament lamp bulbs or filling them with a specially prepared inert gas consisting in absorbing the residual oxygen in a roughly exhausted bulb chemically by de-oxydising agents within an extension of the sealed bulb which is heated externally.

16,112/15. **Ohmmeters.** H. E TRENT. An improved form of ohmmeter, having a coil for electrically restoring the moving system, and constructed so as to be capable of a larger range of deflection than hitherto. The sensitiveness of the instrument for small deflections is increased by neutralising the force of the restoring coil in the initial stages, by a coil exerting an attraction on a number carried by the pointer spindle.

9,111/16 (*100,796*). **Improving Boiler Efficiency.** BRITISH WESTINGHOUSE ELECTRIC and MANUFACTURING Co. Preventing the heat insulating effect of a film of vapour on the heat transmission surface of a boiler by providing an asymmetrical electric conducting film on the liquid engaging surface of the container and establishing a difference of potential between the liquid and the container.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Arc Lamps: BRITISH WESTINGHOUSE ELECT. & MNF. Co. (*Westinghouse Elect. & Mnf. Co.*) [Arc lamps] 8,359/16 (*102,221*).

Distributing Systems, Cables and Wires, Insulating Materials, &c.: WILLIAMS [Distribution systems] 13,504/15.

Dynamos, Motors and Transformers: EBORALL (*A. G. Brown, Boveri et Cie.*) [Dynamo electric machinery] 16,464/15; NEULAND [A.C. motors] 16,476/15.

Electrometallurgy and Electrochemistry: TAINTON and PRING [Electro-deposition and extraction of zinc] 16,336/15; MACKAY COPPER PROCESS Co., 1,278/16 (*100,264*).

Heating and Cooking: BERRY [Radiators] 16,994/15.

Ignition: A. E. LAMKIN [Sparking plugs] 8,470/15.

Switchgear, Fuses and Fittings: BROOK and BISHOP [Switches] 16,846/15. H. E. MITCHELL [Mounting for switches, &c.] 679/16 (*102,167*); R. H. WILLIAMS [Switches] 2,114/16 (*102,184*); S. FILDES [Cord grips] 2,478/16 (*102,188*).

Telephony and Telegraphy: BRITISH THOMSON-HOUSTON Co. (*G.E. Co., U.S.A.*) [Wireless signalling] 14,769/15; E. A. LAIDLAW [Holders for telephones] 2,896/16 (*101,753*); R. ANTONIO [Telegraph transmission devices] 6,329/16 (*102,214*).

Traction: BIDDLE [Automatic signalling] 13,214/15.

Miscellaneous: FARGO [Connectors] 12,150 & 12,151/15; BRITISH THOMSON-HOUSTON Co. (*G.E. Co., U.S.A.*) [Production of current waves] 16,443/15; WILSON [Electric welding] 18,114/15; C. E. CAMPBELL [X-ray apparatus] 6,483/16 (*101,143*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Ignition: SOC. CLERGET, BLIN ET CIE. [Sparking plugs] 16,248/16 (*102,260*); C. T. MASON [Ignition dynamos] 16,512/16 (*102,265*), 16,513/16 (*102,266*), 16,514/16 (*102,267*), 16,518/16 (*102,268*).

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

27,769/02. **Motor-starters.** E. A. CAROLAN (*G.E. Co., U.S.A.*). A motor-starter with overload and underload releases, in which arcing cannot take place at the rheostat contacts and the arm cannot be kept in an intermediate position.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: KÖRTING and MATHIESSEN A.G. [Flame arc lamps] 17,421/08.

Dynamos, Motors, and Transformers: C. A. PARSONS and G. G. STONEY [Parallel running of machines with compensating windings] 18,255/04; A. SCHERBIUS [Compensating windings] 18,817/06; M. WALKER [Flanged commutators] 19,010/07.

Switchgear, Fuses, and Fittings: BRITISH THOMSON-HOUSTON Co. (*G.E. Co., U.S.A.*) [Control of watertight-door motors] 18,877/06.

Telephony and Telegraphy: K. WEINAN [Hand combination telephones] 18,889/06.

Traction: K. VON KANDO [Catenary suspension of overhead contact lines] 18,793/07 and [Collectors] 18,924/07.

LOCAL NOTES

Ashton-under-Lyne: *Proposed Purchase of Tramways.*—The Corporation has decided to promote next session a Bill to purchase the undertaking of the Oldham, Ashton, and Hyde Electric Tramways, Ltd.

Bath: *Lighting Charges Increased.*—The charge for current for lighting purposes has been increased a further one-halfpenny per unit, making it 6d.

Belfast: *Electricity Undertaking.*—The Harbour Commissioners are prepared to lease to the Corporation a site in Hamilton Road for a new electricity works, conditional on the Board of Trade's consent being granted to the erection of a power station there. Sir John Snell and Mr. W. J. Pratten have been communicated with as to any modification they might desire to make in their reports of 1914 as to the new power station. Neither, however, has any serious modification to suggest. The City Electrical Engineer has reported that, having regard to the very small margin of plant available in the power station, he is unable to recommend further connections, but in the event of the Committee deciding to authorise any, subject to the consumer paying the capital charges involved, all possible steps will be taken to secure continuity of the supply. The Chairman of the Committee, in putting this forward, said it had been decided to grant certain applications for current received during the month, but the Committee was unable to grant any more except under very special circumstances. They see nothing for it now but to go on with the new power station if the Government would give sanction to spend the necessary money. It was a very serious thing to hamper industrial and other development by inability to grant electricity supplies.

Bradford: *Free Lamps to be Discontinued.*—The Electricity Committee recommends that notice be given to the consumers of the intention of the Corporation to discontinue the supply of free lamps after December 31st. In lieu of this the discounts are to be increased.

Dublin: *Proposed "Controller."*—The Report of the Special Committee, in which it is recommended Mr. P. W. Dalton should be appointed to manage the electricity undertaking for a period of three years is to be discussed at a special meeting of the Corporation. The Electricity Committee has prepared a vigorous criticism of the Special Committee's Report.

Electricity Accounts.—The accounts of the undertaking

have now been issued for the year to March 31st, 1916. There is a surplus of £8,840, compared with £1,416 in the previous twelve months. The number of units sold was 10,338,558, compared with 9,519,545; whereas the costs per unit sold have increased from 2·62d. to 2·69d. The average price obtained increased from 2·56d. to 2·80d. The capacity of the plant at the end of the year was 12,000 kw., the maximum supply demanded being 7,228 kw. Including the profit for the year, the amount carried forward is £16,443.

Leyton: *Position of Electricity Undertakng.*—A statement has been submitted to the Council showing the position of Leyton compared with fifty-one undertakings in Greater London for the pre-war year ending March, 1914. This statement showed that there are twenty-four undertakings with lower coal costs per unit than Leyton, but of these twenty-one have outputs from 300 to 800 per cent. greater than Leyton. There are thirty-six undertakings in which the oil costs are less than Leyton, but of these twenty-four have greater outputs, whilst of the twenty-nine undertakings which have lower wages costs per unit, twenty-one have greater outputs. The conclusion arrived at from the details of this statement is that making like comparisons, there were only fourteen undertakings whose management costs are less than those of Leyton, yet ten of these have larger outputs. Excluding the ten with the larger outputs, there were only four undertakings with lower working costs.

Ripon: *Electric Lighting Scheme.*—The Board of Trade recently refused to grant the Council an Electric Lighting Provisional Order. The Chairman of the Electricity Committee, however, has interviewed the officials of the Board of Trade in London, who, whilst not prepared to vary their decision, suggest that if some arrangement can be come to with the War Office for utilising the generating plant installed at a certain military camp, and if at the same time the Council can satisfy the Board that there is a demand for electricity in the City, the Board would then be prepared to entertain the application. This suggestion, however, does not apparently appeal to the Council, which has again asked the Board to reconsider its decision and to grant an order in the ordinary course.

Torquay: *Suggested Purchase of Electricity Undertaking.*—Mr. W. B. Cownie, the managing-director of the Torquay Tramways Company, has asked the Corporation, in reference to a proposal to increase the charges for traction supply, if there is any possibility of a sale of the electricity undertaking to the tramways company. Mr. Cownie mentioned a figure in his letter, but the Corporation have replied, however, that it is not contemplated to sell the electricity undertaking. The proposal with regard to the tramway supply is to increase it by one farthing per unit from August 1st, 1915.

Shortage of Labour.—The Deputy-Electrical Engineer has reported upon the inferior men he is obliged to employ upon important work owing to the shortage of labour. He calls the Committee's attention to the matter in case any mishap may occur.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

London: *H.M. Office of Works.*—A twelvemonth's supply of materials for electric bell wiring is required. Controller of Supplies, H.M. Office of Works, King Charles Street, Westminster, S.W. December 19th.

Woolwich.—Extensions estimated to cost £21,000 are recommended in connection with the further supply of power for war purposes. The additional plant is as follows:—Turbo-alternator, super-heater, etc., £11,000; extra high and low tension mains, £9,000; switch-gear for high and low tension mains, £1,000. It is proposed that the necessary loan shall be advanced by the Ministry of Commerce and dealt with on identical terms to the agreement entered into between the Council and the Ministry in connection with a previous loan of £27,500. The terms of the earlier agreement adequately safeguard the Council in the event of the plant not being required after the war.

Worcester.—Messrs. Heenan and Froud have notified the Corporation that they will require a considerable increase in their supply in connection with some urgent war work. The expenditure involved upon this additional supply is estimated at £2,500, but as the Corporation does not feel justified in spending this large sum of money in temporary work, Messrs. Heenan and Froud are asked to contribute £1,800 towards the capital expenditure.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £164 to £168 (last week, £167 to £170).

Agencies.—A representative of a firm in Rome is at present in London with a view to getting into touch with United Kingdom manufacturers of electrical fittings. Communications should be addressed to the Secretary, Statistical and Information Department, London Chamber of Commerce, 97, Cannon Street, E.C.

An Australian firm desires to get into communication with British manufacturers of electrical machinery and sundries.

Agencies in Victoria and Tasmania are sought by a firm desiring to represent United Kingdom manufacturers of switch-gear and electrical instruments. Further particulars at 73, Basinghall Street, E.C.

APPOINTMENTS AND PERSONAL NOTES

A recommendation with regard to an increase in the salary of Mr. H. R. Burnett, the Borough Electrical Engineer at Barrow-in-Furness, has been referred to the General Purposes Committee.

Alderman Duncan Watson, who had intended to retire from the Chairmanship of the Marylebone Electric Supply Committee, has consented to accept the office again until the new and enlarged committee has gained experience of the working of the undertaking.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Electrical Securities Trust.—There was a loss of £564 last year, after meeting interest on debentures amounting to £2,276. The Directors regret that they have been unable to dispose of any of the investments held by the Trust during the past year, but out of cash in hand the trustees, on December 23rd, 1915, made a further distribution of 5 per cent. on the debentures.

Melbourne Electric Supply.—A final dividend of 5 per cent., making 10 per cent. for the year, free of tax, is declared on the consolidated ordinary stock for the financial year ending August 31st.

Adelaide Electric Supply.—A final dividend, making 10 per cent. for the year, with a bonus of 2 per cent., free of tax, is declared on the ordinary shares for the year to August 31st.

NEW COMPANIES

WOLF SAFETY LAMP CO. (Wm. Maurice).—Capital £6,000 (2,000 £1 preference shares and 8,000 1s. ordinary shares). To manufacture and deal in all kinds of incandescent electric lamps. The permanent governing and managing director and chairman is W. Maurice, Star Works, Boston Street, Sheffield.

TRADES DIRECTORY OF ADVERTISERS IN "ELECTRICAL ENGINEERING."

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Edison & Swan United Elec. Light Co., Ltd., Ponders End, Middlx.
Fletcher (H. J.) & Co., Bridge Works, New North Rd., London, N.
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Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff.
Holophane, Ltd., 12, Carteret St., Westminster, S.W.
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Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.
Simpson (C. M.), 4, St. Augustine's Place, Bristol.
Sloog, H., 51, Anson Rd., London, N.W.
Sun Electrical Co., Ltd., 118, Charing Cross Rd., W.C.

ACCUMULATORS, &c.
D.P. Battery Co., Ltd., Bakewell, Derbyshire.
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford.
Tudor Accumulator Co., Ltd., 3, Central Buildings, Westminster.

ARC LAMPS, CARBONS, AND ACCESSORIES.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Elec. Eng'g & Equipm't Co., Ltd., 109 to 111, New Oxford St., W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
London Electric Firm, Croydon.
Oliver Arc Lamp, Ltd., Cambridge place, Burrage Rd., Woolwich.

ARMATURE REPAIRS.
Marryat & Place, 28, Hatton Garden, E.C.

BOILERS.
Babcock & Wilcox, Ltd., Oriel House, Farringdon St., E.C.
Stirling Boiler Co., Ltd., 54, Victoria St., S.W.

CABLES, WIRES, AND DUCTS.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Glover (W.T.) & Co., Trafford Park, Manchester.
Henley's (W.T.) Telegraph Works Co., Ltd., Blomfield St., E.C.
Hooper's Telegraph & Indiarubber Works, Millwall Docks, E.
Johnson & Phillips, Ltd., Charlton, Kent.
Liverpool Electric Cable Co., Ltd., Linacre Lane, Bootle, Liverpool
Morshead (L. R.) & Co., 17, Victoria St., S.W.
St. Helens Cable & Rubber Co., Ltd., Warrington.
Siemens Bros. & Co., Ltd., Woolwich.
Union Cable Co., Ltd., Dagenham Dock, Essex.

CATALOGUES AND PROCESS ENGRAVING.
Swain (John) & Son, Ltd., Shoe Lane, E.C.

COIL WINDING.
Varley Magnet Co., Ltd., Cambridge Place, Burrage Rd., Woolwich.

CONDENSERS (Electrical).
Telegraph Condenser Co., Ltd., Vauxhall St., Kennington Oval, S.E.

DYNAMOS see Motors and Dynamos.

ELECTRIC VEHICLES.
Mossay & Co., 41, Tothill St., Westminster, S.W.

HEATING AND COOKING APPARATUS.
Bastian Electric Co., Ltd., 185, Wardour St., W.C.
British Thomson-Houston Co., Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

INSTRUMENTS.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Nalder Bros. & Thompson, Ltd., 97a Dalston Lane, Dalston, N.E.
Weston Electrical Instrument Co., Audrey House, Ely Place, E.C

INSULATING VARNISH, ENAMELS, PAINTS AND LACQUERS.
Griffiths Bros. & Co., London, Ltd., Macks Rd., Bermondsey, S.E.
Jenson & Nicholson, Ltd., Goswell Works, Stratford, E.
Pinchin Johnson & Co., Ltd., Minerva House, Bevis Marks, E.C.

INSULATORS AND INSULATING MATERIALS.
Macintyre (J.) & Co., Ltd., Burslem.
Mosses & Mitchell, 122 to 124, Golden Lane, E.C.
Weidmann (H.) Ltd., Rapperswil, Switzerland.

INSURANCE.
Phœnix Assurance Co., Phœnix House, King William St., E.C.

LADDERS.
Heathman & Co., 10, Parsons Green, S.W.

LAMPS (Incandescent).
British Thomson-Houston Co., Ltd., 77, Upper Thames St., E.C.
Cryselco, Ltd., Kempston Works, Bedford.
Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
"Lamlok," 18, Ranelagh Gdns., Hammersmith, W.
London & Rugby Engineering Co., Ltd., 36 & 37, Queen St., E.C.
Pope's Electric Lamp Co., Ltd., Hythe Rd., Willesden, N.W.
Siemens Bros. Dynamo Wks., Ltd., 39, Upper Thames St., E.C.
Simplex Conduits, Ltd., 113 to 117, Charing Cross Rd., W.C.

LAMPS (Incandescent)—*contd.*
Stearn Electric Lamp Co., Ltd., 47, Victoria St., S.W.

LAMP FILAMENTS.
Gmur & Co., Ltd., Aarau, Switzerland.

LEAD, &c.
Capper, Pass & Son, Ltd., Bedminster Smelting Works, Bristol.

LIFTS.
Waygood-Otis, Ltd., Falmouth Rd., S.E.

LUMINOUS PAINT.
Fredk. Crane Chemical Co., Armoury Close, Birmingham.

MECHANICAL STOKERS.
Underfeed Stoker Co., Ltd., Coventry House, South Place, E.C.

METAL PERFORATORS.
Harvey (G. A.) & Co. (London), Ltd., Woolwich Rd., London, S.E.

METERS.
Bastian Meter Co., Ltd., Kentish Town, N.W.
British Thomson-Houston Co., Ltd., Rugby.
Ferranti, Ltd., Central House, Kingsway, W.C.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.

MICA.
British Mica Co., Ltd.. Lebanon Rd., Works, Wandsworth, S.W.
Wiggins (F.), & Sons, 102 to 104, Minories, E.C.

MINE EQUIPMENTS AND APPARATUS.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Reyrolle & Co., Ltd., Hebburn-on-Tyne.
Siemens Bros, Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Willans & Robinson, Ltd., Rugby.

MOTORS AND DYNAMOS.
British Thomson-Houston Co.. Ltd., Rugby.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Langdon-Davies Motor Co., 110, Cannon St., E.C.
Matthews & Yates, Ltd., Swinton, Manchester.
Peebles (Bruce) & Co., Ltd., Edinburgh.
Siemens Bros. Dynamo Works, Ltd., Caxton Ho. Westminster, S.W.
Vickers, Ltd., River Don Works, Sheffield.

OIL CANS.
Kaye (J.) & Sons, Ltd., Lock Works, Leeds.

PACKING.
Dermatine Co., Ltd., Neate St., London, S.E.

PUMPING PLANT.
General Electric Co., Ltd., 67, Queen Victoria St., E.C.
Merryweather & Sons. Fire Engine Works, Greenwich, S.E.
Willans & Robinson, Ltd., Rugby.

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Ingram (J. G.) & Son, Hackney Wick, N.E.
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Allen (W. H.) Son & Co., Ltd., Queen's Engineering Works, Bedford.
British Thomson-Houston Co., Ltd., Rugby.
Dick, Kerr & Co Ltd., Abchurch Yard, E.C.
J. Howden & Co., Ltd., 195, Scotland St., Glasgow.
Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk St., W.C.
Vickers, Ltd., River Don Works, Sheffield.
Willans & Robinson, Ltd., Rugby.

STEAM ENGINE ACCESSORIES.
Lea Recorder Co., Ltd., 32, Deansgate, Manchester.
United States Metallic Packing Co., Ltd., Bradford.

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British Thomson-Houston Co., Ltd., Rugby.
Dorman & Smith, Ltd., Ordsal Electrical Works, Salford.
Drake & Gorham, Ltd., 1, Felix St., Westminster Bridge Rd., S.E.
Edison Swan Electric Co. (The) Ltd., Ponders End, Middlesex.
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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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Reyrolle & Co., Ltd., Hebburn-on-Tyne.

TECHNICAL BOOKS.
Caxton Publishing Co., Clun House, Surrey St., Strand, W.C.
Constable (Archibald) & Co., Ltd., 10, Orange St., Haymarket, W.
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General Electric Co., Ltd., 67, Queen Victoria St., E.C.
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Siemens Bros. & Co., Ltd., Woolwich.
Western Electric Co., Ltd., North Woolwich, E.

TESTING LABORATORIES.
Electrical Standardising, Testing and Training Institution, Ltd., 62 to 70, Southampton Row, W.C.

WIRING CONTRACTORS. See page iv.

WOODWORK CASING AND CONDUITS.
Jennings & Co., Pennywell Rd., Bristol.

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SUMMARY

OWING to the approach of Christmas, no technical question is offered for competitive replies this week.

IN a Paper read last Thursday at a meeting of the Institution of Electrical Engineers, Mr. R. W. Weightman gave a general survey of telegraph and telephone practice in the Colonies (p. 476).

THE Federation of British Industries has prepared a series of important recommendations with regard to the promotion of British trade in foreign countries. They aim mainly at businesslike management in our Government Departments (p. 477).

AN interesting review of war economies in lighting was given at the last meeting of the Illuminating Engineering Society. The great waste that is now going on with our present methods of lighting the streets was commented upon, as also was the fact that the Society offered its expert assistance to the authorities two years ago, but advantage was not taken of the offer (p. 478).

Two recent Papers read before the American Institute of Electrical Engineers deal with temperature use in electrical machinery (p. 479).

AMONG the subjects of specifications published at the Patent Office on Thursday last were wireless telegraphy and enclosed tungsten arc lamps (p. 479).

THE Government has intervened to prevent a tramway strike in Lancashire.—Further increases in charges for electric supply are notified in various places.—An industrial development committee has been formed at Sheffield (p. 480).

FERRANTI'S show a profit of £3,500 against a loss of £1,000 last year. The Silvertown Co. pay a dividend of 10 per cent. (p. 480).

1st LONDON ENGINEER VOLUNTEERS

HEADQUARTERS, CHESTER HOUSE, ECCLESTON PLACE.
ORDERS FOR THE WEEK BY LIEUT.-COL. C. B. CLAY, V.D., COMMANDING.

Officer for the week.—Platoon Commander L. C. Hughes Hallett.

Next for duty.—Platoon Commander J. O. Cheadle.

Resignation.—Platoon Commander N. E. Brown resigns his appointment (dated Dec. 16th, 1916).

From *Thursday, Dec. 21st, to Thursday, Dec 28th,* inclusive.—Headquarters closed.

Friday, Dec. 29th.—Technical for Platoon No. 10 at Regency Street. Squad and platoon drill, Platoon No. 9. Signalling class. Recruits' drill, 6.25 to 8.25.

Musketry.—For all Companies, see notice at Headquarters.

Unless otherwise indicated, all drills, &c., will take place at Headquarters.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Principles of the Telephone, Part I.: Subscriber's Apparatus. By C. M. Jansky and D. C. Faber. 9½ by 6 in. 160 pp. 125 figures. (New York: McGraw Hill Book Co.; London: Hill Publishing Co., Ltd.) 6s. 3d. net.

WE have here a thoroughly practical book for those engaged in actual telephone work, written by two professors in the University of Wisconsin, with assistance from engineers of the Wisconsin Telephone Co. Obviously, the whole refers to American practice, but as British telephone work was so largely based originally on Transatlantic experience this is not so much of a disadvantage as might appear at first sight. The present volume is devoted entirely to apparatus for the subscriber's end of the line, but we understand that sequels are in preparation on exchange equipment and outside construction. The general principles underlying the action of such apparatus are clearly set forth and a valuable part of the work is that devoted to methods of localising and correcting faults. Little previous knowledge of electrical matters is assumed, and the collection of questions at the end of each chapter will be found useful by the reader in testing the knowledge that he has acquired. After certain introductory matter, and a consideration of general principles of electricity and sound, modern forms of transmitters are dealt with in more detail and subsequently receivers, induction coils, bells, magnets, switch hooks and other items of the subscriber's equipment are considered in detail. The local and "common" battery systems of working are then explained, and further chapters deal with sub-station telephone apparatus, line protection installation and party lines. Inter-communication systems only receive brief treatment in a final section. The book is well illustrated and it is a relief to find a work of this nature absolutely unfettered with descriptions of the obsolete.

Telegraphy. By T. E. Herbert. 985 pp. 7½ by 5 in. 630 figures. (London: Whittaker and Co.) Third edition. 9s. net; abroad, 9s. 9d.

ORIGINALLY published some ten years ago and now revised again for its third edition, this book is mainly devoted to giving an up-to-date and detailed description of the telegraph practice of the British Post Office, while a certain amount of elementary matter is also introduced with the object of candidates for the Departmental and City and Guilds examinations in telegraphy. The method of treatment adopted calls for but little mathematics. Naturally, since the original edition, considerable developments have taken place, necessitating additions and modifications. Modified forms of Tidandi cell have, for example, replaced older wet cells, and the use of central battery systems has been greatly extended, and numerous duplex methods of working on this system have been evolved. An even more far-reaching change has been the increasing adoption of the Baudot and Murray printing telegraphs, including the latest multiple developments of the latter. The speed of the Wheatstone automatic system has been further increased by keyboard perforators and receiving perforators, and the Siemens high-speed automatic system is another interesting new development. The use of the well-known megger for telegraph work has revolutionised some of the older testing methods, and all these matters receive their due share of treatment.

Principles of Alternating Current Machinery. By R. R. Lawrence. 614 pp. 8½ by 5¾ in. 273 figures. (New York: McGraw Hill Book Co.; London: Hill Publishing Co., Ltd.) 18s. 9d. net.

THIS is an addition to the already large number of text books by teachers of electrical engineering in American technical colleges and is founded on a lecture course to senior students at the Massachusetts Institute of Technology. Dealing with A.C. machinery only it forms the second of a series and follows a similar text book on D.C. machines. The principles underlying the design and working of alternators, transformers, A.C. motors, etc., are gone into clearly and thoroughly, and mathematics are freely employed. Principles are dealt with rather than details of actual machines, and the work is addressed to the general student of electrical engineering rather than the specialist in A.C. designs.

COLONIAL TELEGRAPHS AND TELEPHONES

A PAPER on this subject by Mr. R. W. Weightman was read at last Thursday's meeting of the Institution of Electrical Engineers. In his introductory remarks he said that Canadian methods differed somewhat from those followed in other Dominions and Colonies in that they were based on American practice as distinguished from British Post Office practice, followed with but slight modifications elsewhere. After a few words as to the appointment of engineers for Colonial telegraph work and the nature of the working staffs available in different parts of the world, the author referred briefly to some of the difficulties in the way of sources of supply and delays in delivery, which are features of oversea work. He then passed on to particulars of the administration of the Colonial telegraph and telephone undertakings. The methods are naturally varied to meet the local conditions, but in all the Dominions (with the exception of Canada) and also in all the larger Crown Colonies the telegraphs and telephones are combined with the postal service of the country, and the Postmaster-General is the officer responsible to the Government for the proper management of the organisation as a whole. In some instances the office of Postmaster-General is a political one, and in such a case the permanent head of the Department is the Secretary as in England.

Coming on to the subject of overhead construction, the author said that there was practically no overhouse construction in any of the Dominions or Colonies. The chief difference in the construction of pole lines lies in the character of the pole employed. This again mainly depends upon whether or not a country is a timber-producing one. Where timber is plentiful and there are no local drawbacks to its use, wood poles are the rule, but where it is scarce or not of suitable size or quality, or where it is liable to be attacked by white ants, or destroyed by grass or bush fires, iron poles are used.

In the Crown Colonies and South Africa there are two types of tubular iron poles with cast-iron bases and wrought-iron taper upper tubes in general use in the Crown Colonies. The advantage in the tapering top is that it combines strength with lightness. The taper is lap-welded in machines specially designed for the purpose. In the original joint the space between the tube and the base was filled with a sulphur-oxide-of-iron cement, but in nearly all poles ordered now either the screw ring joint or the taper ring joint is used.

In all these poles the cast-iron base is of sufficient length to keep the wrought-iron tube out of the ground when the pole is planted to its proper depth.

In some of the Crown Colonies tubular poles of the type introduced by the Indian Government and known as the Hamilton pole are used. These consist of riveted tubes of steel sheet fitting into cast-iron sockets having cast-iron sole plates. A full-length pole is about 58 ft. out of the ground, and it comprises eight sections each 8 ft. long. The poles taper from about 12 in. at the bottom to 3 in. at the top.

The number of poles to the mile varies with the class of line. Twenty to the mile may be said to be the lowest number that is allowed on a light country line, but the author knows lines on which the average per mile is much below this figure. From this the number ranges up to 40 to the mile.

Where iron poles are employed near the sea they can only be preserved from corrosion by being frequently painted or tarred. Reinforced concrete poles would be more serviceable than iron in these situations, but the weights of these poles in proportion to their strengths are against them for lines where the difficulty of transport is a serious factor. It seems to the author that there should be a field for these poles in countries where the principal ingredients, cement and sand, are available, so that with a portable pole-making plant the poles could be made in the vicinity of the line in each case. Hollow reinforced concrete bases made in moulds locally and fitted with wood tops are sometimes used. Discarded railway rails are also used at certain places, the rails being set with the web of the rail at right angles to the direction of the line. Planted the other way about they are liable to bend over in very windy weather.

In Canada wood poles and arms obtained from timber grown in the country are used on both telegraph and telephone lines. There are no iron or reinforced concrete poles in use.

New Zealand has a greater variety of types of poles than most coutries. Poles of wood, tubular iron, reinforced concrete, and discarded railway rails are in use. The wood poles are mainly got from indigenous trees.

Tubular iron and steel poles have come more into use within the past few years. They are of both solid drawn and lap-welded types, although not of the standard taper pattern so much employed in South Africa and other countries. They are used in the larger towns for telephone exchange distribution purposes, also in the lighter sizes on some light country lines where it is advantageous to use them owing to the ease with which they can be transported and handled over rough country.

The author describes a considerable number of brackets, arms and other pole fittings used in various places. With regard to insulators, double-shed white porcelain insulators of Post Office types are generally used in these Colonies and in South Africa. On the farmers' lines in South Africa and on some lines in British East Africa a small single-shed porcelain cup is used. It is quite a satisfactory light line insulator for use where the climate is dry. The spindles and cupholders used with these cups are generally of the standard types adopted by the British Engineering Standards Committee, although for light conductors single and double **J** and also **U** cupholders of lighter patterns are used. For leading-in purposes the Purves-Sinnott pot-head insulator is now much used in the single and double groove and side knob patterns in which it is made. Bright's shackles are practically obsolete as in England, but they are still used here and there in spite of the large and direct surface they offer for leakage. Glass insulators so much used in the United States and Canada, where the climate is dry, are not used to any extent in the Crown Colonies and not at all in South Africa. Copper and iron line wire are both extensively used.

The systems, apparatus and circuits used in the Crown Colonies are generally those standardised by the Post Office. Single needle, single and double-current Morse, double-current duplex and quadruplex are employed in the different Colonies. The Cardew vibrator is also used a good deal, in some cases superimposed on Morse lines, and also in place of the Morse on lines that suffer chronically from low insulation. In British East Africa and Uganda, Wheatstone automatic has been introduced with Gell keyboard, and ordinary mechanical perforators. The Vyles polarised sounder is replacing the sounder and relay, and is also being adopted with condensers on Central battery omnibus circuits. At Colombo, Ceylon, the Baudot system has been installed on a circuit 800 miles in length, connecting with Madras. In Canadian practice minor circuits are worked single current on the closed-circuit system, the battery power being divided generally between the two terminal stations.

In Australia Morse sounder and Morse printer apparatus is used on the minor telegraph circuits worked on the closed-circuit system. Morse duplex and quadruplex are employed on the busier circuits. Telephones are now frequently used where formerly Morse apparatus would have been installed. The introduction of either the Murray or Western Electric multiplex or the Baudot system is under consideration. The Wheatstone automatic is in constant use for both ordinary and Press work between the main centres, and this system has recently been extended. In New Zealand single-current Morse, both open and closed circuit, Morse duplex and quadruplex are the principal systems in use and the apparatus is generally of British Post Office type.

The latter part of the paper is devoted to details of the telephone systems of the various Dominions and Colonies. There are many magnetic exchanges of moderate size varying somewhat in detail in the Crown Colonies, but no automatic exchanges. In South Africa the number of telephones per 100 of the population not including natives is about three. The telephone services throughout the country are under the Government with the exception of the Durban exchange, which is owned and worked by the municipality. Every town and village of any importance has its exchange, and a large trunk system has been developed. At present the longest connections in regular use are about 500 miles in length. A speech efficiency equal to 30 miles of standard cable is aimed at, and inter-communication is given to all stations that come within this limit. Loading coils have not yet been introduced, but they will be employed when the time arrives to consider the longer trunk lines between the Cape and Transvaal main centres. At the principal Government exchanges central-battery manual boards are in use, the largest being that at Johannesburg, with an ultimate capacity of 9,000 lines.

In Canada the Bell Company have central-battery manual systems in their larger exchanges, and in exchanges below 500 or 600 lines they use magneto boards. They have no automatic exchanges. The practice of the Manitoba Government Department is on similar lines. Their magneto boards are fitted with plug-restoring line signals of the eyeball type. In Alberta and Saskatchewan the Government exchanges at Calgary, Medicine Hat, Lethbridge, Regina, and Saskatoon are equipped with the Strowger automatic system as is also the municipal exchange at Edmonton. This latter exchange

was started in 1907 with a 500-line installation, but is now for 10,800 lines, of which 9,300 are connected. It is spread over four exchanges and an area of roughly 20 square miles. All other exchanges in these two provinces are magneto except two central-battery manual exchanges at Saskatchewan. There is no through communication yet between the Eastern and Western shores of Canada. There is a break of 600 miles between Fort William and Kenora in which there is no telephone line at all, and the Rocky Mountains form another break between Alberta and British Columbia. The longest lines regularly in use in Canadian territory are those between Montreal and Windsor, and Montreal and North Bay, distances of about 600 miles. Loading coils are in use on both open-wire and underground sections of the long-distance circuits.

Probably no country in the world has taken up automatic telephony so whole-heartedly as the Australian Commonwealth. Full automatic equipment has been installed in 10 exchanges, the largest of which is Perth with over 3,000 subscribers. Six other exchanges are in course of construction or approved, tenders have been invited for a further 18 and 14 others are under consideration. The exchanges so far opened are all equipped with the Strowger system, but both the Siemens and the Western Electric Company's systems are to be tried.

New Zealand was very early in the field in establishing telephone exchanges at its principal centres, and many of the exchanges installed between 20 and 30 years ago are still in operation. The boards are mostly of the old Western Electric magneto type with branching multiple and with drop-shutter line and ring-off indicators.

PROMOTION OF BRITISH TRADE IN FOREIGN COUNTRIES

THE Executive Council of the Federation of British Industries has prepared a number of recommendations in regard to the promotion of British trade in foreign countries. This is a matter of urgent and vital importance to the future of the prosperity of the country, and although the Advisory Committee of the Board of Trade has already gone into this matter in some detail, the summary of the recommendations in question given below lose nothing in importance by this fact.

Summary of recommendations in regard to promotion of British trade in foreign countries :—

Control.—That all the activities undertaken by the Government in connection with the promotion of British trade in foreign countries should be concentrated in a single department.

Selection of Department for Control.—That this department must be the Foreign Office.

Duties of this Department.—That the commercial duties of the Foreign Office and foreign services should include :— (*a*) The direction of all services abroad. (*b*) The collection and distribution of all industrial, financial and commercial information relating to foreign countries. (*c*) The prompt and vigorous support of all British efforts to secure contracts, concessions or orders. (*d*) Advice to the department in charge of industrial and commercial affairs on all questions in the United Kingdom which may affect foreign trade. (*e*) Advice to His Majesty's Government as to the conditions on which they should permit the issue of foreign loans in the United Kingdom.

Co-ordination with Other Departments.—That really efficient machinery should be established to co-ordinate the work of the Foreign Office and of the department in charge of industrial and commercial affairs.

Funds.—That in order to enable the Foreign Office and foreign services to undertake the re-organisation and expansion necessary to the efficient discharge of the functions enumerated above, a large increase should be made in the funds placed at their disposal.

Re-organisation.—That the re-organisation of the Foreign Office and foreign services should be on the following lines.

Foreign Office.—(1) The establishment of a large commercial branch, with the provision of extra staff and accommodation on a generous scale.

(2) This branch to be in the closest possible touch with the industrial and commercial community : (*a*) By frequent personal interviews. (*b*) By personal visits to industrial centres. (*c*) By the appointment of small committees, composed of representatives of the firms most actively interested, to advise the various sections of the commercial branch on matters connected with the countries with which they deal, and to offer suggestions and criticism. (*d*) By the appointment of a central committee, on which prominent members of the industrial and commercial community should form an important element, to perform the same advisory and critical functions for Government departments generally.

The Diplomatic Service.—(1) Increase of staff to enable sufficient time to be devoted to the study of industrial and commercial questions. (2) Insistence that commercial work forms a most important part of the duties of the service, and that a certain period during an officer's service in each grade should be devoted especially to this work as an essential qualification for promotion.

The Commercial Attaché Service.—This should be replaced by the appointment of officers of high rank, to be known as commercial counsellors, to each embassy or legation, to be in sole charge, under the Minister or Ambassador, of all commercial work in the country. These officers to be given one or more assistants, and rank, emoluments and position second only to that of the Minister or Ambassador, and to be regarded as regular members of the diplomatic service.

The Consular Service.—(1) The commercial work of this service to be subject to the direction of the commercial counsellors. (2) A large increase in the numbers of the regular service. (3) A redistribution of posts to correspond with commercial needs. (4) Reduction to a minimum of the posts held by unpaid consuls. (5) Provision of sufficient clerical and other assistance to enable consular officers to devote the bulk of their time to commercial work. (6) Provision of adequate local and travelling allowances.

All Services.—(1) Only natural born British subjects to be eligible for appointment to any post, paid or unpaid. (2) The introduction of a small number of men with practical business experience especially into the commercial branch of the Foreign Office and the commercial counsellor service. (3) The establishment of a definite and high standard of efficiency which must be reached by all officers at different stages of their career. This standard to be administered by a promotion board with power to postpone the promotion of any officer who does not reach the standard, to demand the resignation of any officer who falls far short of it, and to grant a pension commensurate with past services to any officer whose resignation is demanded.

Training.—Should be based upon a preliminary test of general ability and of a sound general education, to be followed after appointment by a special course in elementary economics, commercial method, and two or more foreign languages. Training should be completed by actual experience of the work of the service, supplemented by frequent opportunities of visiting industrial centres and of acquiring practical knowledge of industrial and commercial questions.

Experts.—A large number of technical and commercial experts should be selected and sent, when required, to investigate and report upon industrial and commercial conditions and opportunities in particular countries and particular markets. Ample funds should be provided to enable the best possible advice to be obtained, and these investigations to be made with sufficient frequency and thoroughness.

WAR ECONOMIES IN LIGHTING

AT the first meeting of the Session of the Illuminating Engineering Society on Friday, Mr. L. Gaster, the Hon. Secretary, gave his usual account of progress during the vacation. In the past, on such occasions, there have been references to the participation of the Society in various International Congresses. Now, unhappily, there is no such international co-operation to record. But a number of recent events illustrate very clearly that in the present times there are opportunities as fruitful as in times of peace—and possibly even more so—for the exertion of the influence of the Society.

After referring to the very sad loss the Society had sustained in the death of Professor Silvanus P. Thompson, President during the first four years of existence of the Society, the development of illuminating engineering in the United States was touched upon. Many aspects of lighting are necessarily in abeyance, but it is gratifying to see that in the United States illuminating engineering is making steady progress. At the recent Convention an interesting series of papers and reports was presented, and the course of lectures arranged at the Pennsylvania University will furnish a useful precedent for the future. Among other points of interest is the report on nomenclature and units. This list of terms and symbols will require consideration in European coun-

tries. Of special interest is the decision taken to adopt the "lumen" as a measure of the illuminating power of all kinds of lamps—a matter which, it is hoped, will receive the attention of the Society early in the new year. Yet another indication of progress is the decision of two States, Pennsylvania and New Jersey, to adopt legislation on the illumination of factories, in which the intensity required for various purposes is specified. The requirements appear to be broadly in agreement with those of the Departmental Committee of the Home Office in this country.

In other directions, notably in connection with street and spectacular lighting, progress has also been made. The method of flood-lighting, according to which the faces of buildings or signs, etc., are completely illuminated by a projected beam from a concealed source, appears to be coming popular. This method formed an important feature in the highly novel lighting devices employed at the Panama-Pacific Exhibition. We in England are at present debarred from the development of the artistic and decorative sides of exterior lighting, but, with a view to the future, it is well to make note of the new methods that are being introduced elsewhere.

In other directions there are developments now taking place which may have a profound influence in the future. We see everywhere tendencies towards co-operation, and, while some of these are only indirectly associated with illumination, they suggest possibilities of similar action in our own sphere.

Coming next to the question of economy in artificial light, it is pointed out that the mere diminution of illumination in cases where it is even at present insufficient for the purpose in view, is false economy. The conclusions of the Home Office Report on Factory Lighting that good illumination is essential in factories and workshops, and that defective illumination leads to diminished output, spoiled work, and an increased number of accidents, are strongly endorsed in a series of bulletins issued by the Committee on the Health of Munition Workers during the present year, particularly in No. 9, relating to Ventilation and Lighting of Munition Factories, and No. 15 (just issued) on the Effect of Industrial Conditions on Eyesight.

A well-considered scheme of economy, therefore, can be made effective only through the systematic education of people to appreciate the proper use of light, and the authorities would greatly assist the objects they have in view if they were to make use of the Society to prepare definite instructions on the subject to various classes of the community. There is reason to believe that suggestions from the Society in the proper quarter would receive sympathetic consideration.

Meantime we have before us every day many examples of wasted light. We see lamps in shop-windows shrouded with coloured paper or obscuring lacquer so that a mere fraction of the light produced is allowed to penetrate though the screen and carry out any useful purpose. In interiors we see old and wasteful types of lamps still employed, or lamps used without any adequate form of shade or reflector, throwing a large part of the light where it is not required. One difficulty which one meets in making economies is that of obtaining a proper supply of the best type of reflectors. The shortage is presumably due largely to the exceptional demands of munition factories, and to limitations in manufacturing facilities or material. It may be that this is a case in which we have to submit to present inconveniences, but it should be clearly understood that this is in no sense an economy. The cost of installing proper lighting appliances is small in comparison with the saving over a number of years in gas or electric consumption, not to mention the effect of unsatisfactory lighting on the output and quality of work.

Assuming the need for economy, we are still in want of more definite information on the intensities of illumination actually required for various processes. This point was discussed at the time of the issue of the Home Office Report, and it will be recalled that in the American Code on Factory Lighting a rough classification of the illumination needed for safety and convenience, and for rough and fine manufacturing operations, was attempted. So far, however, there has not been an exhaustive scientific investigation, based on actual results achieved with varying amounts of illumination. It is common knowledge that, with the introduction of more powerful lamps during the last ten years, the standard of illumination in interiors has steadily risen. There is good ground for thinking that this progressive change is well justified, and that the order of illumination prevailing in the days of carbon filament electric lamps and flat flame gas burners was often too low for modern strenuous work. In many instances it was certainly under a foot-candle. Yet, from the standpoint of economy, it would be very important to determine the approximate upper limits, beyond which no gain in output or quality of work is to be obtained. A most instructive experiment is being conducted by the Commonwealth Edison Co. in the United States. A factory is being lighted in accordance with the best modern practice, and arrangements are being made for increasing at will the illumination to three times its present value. The experiment will be carried on for at least four months, the two methods of lighting being used alternately at intervals of a month, and a careful check of the output and quality of work kept throughout the entire period.

As to the lighting conditions in the streets, if the assistance of those who have made a study of illumination for years was more effectively utilised, it might be possible to improve on the present arrangements in many respects—to make economies that would be very desirable at the present moment, and to provide conditions of illumination which, while meeting the views of the authorities, would make the streets more tolerable for traffic and pedestrians.

When the diminution in illumination was first undertaken the Society offered its services to the authorities. Subsequently, early in 1915, a Joint Committee was formed with a view to aiding the authorities in this matter. Two years have elapsed, and there is now opportunity to judge the effect of these lighting conditions. One fact that has been strikingly brought out is the increase in the number of street traffic accidents.

The relation between diminished illumination and accidents deserves careful study, and the following additional information would furnish useful data for drawing conclusions on this matter :—

(1) The returns of the accidents during *each month* of the period referred to above.

(2) The respective numbers of accidents in each month during the day, and between sunset and sunrise.

(3) The dates at which further restrictions in lighting have been introduced.

(4) The approximate figures for the number of licensed motor vehicles, tramcars, etc., plying in London in each month.

(5) The dates at which restrictions, if any, in the speed of such vehicles, have been introduced.

It is evident that the greatest measure for safety of the streets would be more scientific darkening of the lights. One undesirable feature of the present arrangements, to which attention was called in 1914, is the extreme "patchiness" and uneven distribution of light, giving rise to severe contrasts of light and darkness. There seems reason to believe that this inconvenient effect has not been deliberately sought for any purpose, and that it is merely the accidental result of the crude methods of shielding the lights now being employed. One of the first points to receive attention in a scientific inquiry would doubtless be the elimination of these severe contrasts in light and shade, which are distracting alike to drivers and pedestrians, and are probably not desirable, as forming distinct marks on the roads when viewed from above. The great variety in method prevailing in different districts apparently arises through the fact that a number of different authorities are concerned with the matter, whose directions are often more or less conflicting. In addition, it would appear from the results that the actual measures taken are often decided by people who have little experience of lighting problems, and do not appreciate the great difference in convenience occasioned by apparently small variations in procedure in dealing with public lamps.

The general question of experimental research in illumination then received some consideration. At the annual meeting of the Society last May the Research Committee presented a report containing a list of investigations with which the Society might usefully occupy itself. One of the most encouraging signs during the past two years has been the growing recognition of the need for scientific and systematised research, and we appear now to have reached a stage where investigations of value will receive sympathetic consideration from the Government, which is in a much better position to give practical support.

Therefore, at the present moment there is a great opportunity for initiating research in the lighting industry, and the Society has in view a number of specific researches with which to approach the authorities.

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published December 14th, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

14,769/15. **Wireless Telegraphy.** British Thomson-Houston Co. (*G.E. Co., U.S.A.*). A wireless transmission system having an antenna and a source of high-frequency current for producing oscillations therein, in which the amplitude of the oscillations is varied by means of an electron discharge relay in a circuit inductively coupled to the antenna or to an intermediate circuit containing the source of the high-frequency current in accordance with the signal to be transmitted.

16,443/15. **Wireless Telegraphy.** British Thomson-Houston Co. (*G.E. Co., U.S.A.*). A wireless system employing a current wave which is the equivalent of two waves of different frequencies and of constant amplitudes. A fundamental wave of constant amplitude is produced by a frequency intermediate to that of the two waves, and amplitude of the pulsation of the fundamental wave is varied to produce a current wave with pulsation which can be resolved into two current waves of constant amplitudes, one of a higher and the other of a lower frequency than the fundamental.

8,359/16 (*102,221*). **Tungsten Arc Lamp.** British Westinghouse Electric & Manufacturing Co. (*Westinghouse Elect. & Mnf. Co., U.S.A.*). An arc lamp with tungsten electrodes enclosed in a sealed bulb, in which increased luminosity is obtained by the presence in the bulb of vapours of titanium tetrachloride, tungsten tetrachloride, or boron trichloride.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Summaries of some of the more important of these Patents will appear in our next issue.

Electrometallurgy and Electrochemistry: Jenkins and C. I. Syndicate [Electrolytic cells] 16,643/15.

Ignition: L. Bignon and J. C. Rousset [Automatic ignition advance for magnetos] 13,820/15 (*101,712*).

Instruments and Meters: British Westinghouse Elect. & Mnf. Co. (*Westinghouse Elect. & Mnf. Co., U.S.A.*) [Meters and relays] 8,310/15 (*102,335*).

Switchgear, Fuses, and Fittings: G. D. Peters & Co., Hibberd and King [Electromagnetic switches] 16,765/15.

Telephony and Telegraphy: F. Palmer [Telegraph key] 7,334/16 (*100,590*).

Miscellaneous: Gibson and Benns [Portable lamps] 16,865/15; E. Woltmann [Welding apparatus] 6,036/15 (*100,401*).

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Electrometallurgy and Electrochemistry: H. and R. S. Hutton [Electroplating] 18,246/08.

Incandescent Lamps: J. Kremensky [Sealing in, &c., of metal-filament lamps] 18,278 and 18,279/08.

Switchgear, Fuses, and Fittings: M. B. Field and Ferranti, Ltd. [Solenoid operated oil circuit-breakers] 17,699/05.

TEMPERATURE RISE IN ELECTRICAL MACHINERY

Among recent papers read before the American Institute of Electrical Engineers was one by Mr. B. G. Lamme dealing with certain fundamental principles governing heat distribution and temperature in electrical apparatus. The general problems of heat generation, heat flow and heat dissipation, upon which the resultant temperatures depend, are discussed at some length. The various paths of heat flow and the effects of the heat resistance of such paths are discussed. The effects of rapid heat flow on the equalisation of the temperatures, and on their measurement, are considered briefly. Some of the fallacies in temperature guarantees and in temperature indications are pointed out. Some of the more common errors in the methods of measurement are described. In conclusion it is stated that no hard and fast rules can be made to cover the facts, except in a very general way, and that commercial temperature measurements should be considered as approximate, this being permissible because there is no sharply defined line between good and bad.

At the same meeting Mr. F. D. Newbury read a paper entitled "Rational Temperature Guarantees for Large A.C. Generator." The paper is an argument for the standardisation of temperature guarantees when the guarantee is based on internal temperatures as measured by thermo-couples. It is recommended that in all cases the maximum safe operating temperature of the insulation be used as the temperature guarantee, instead of using a lower temperature. The standardised guarantee, 50-deg. rise by thermometer, is cited in comparison with the present wide range of temperature rises, from 60 deg. to 100 deg., that have been called for in specifications when the thermo-couple method of measurement is used. Arguments are presented from the standpoint of both the designing and the operating engineer for the use of this standardised temperature rise. Curves are shown illustrating the temperature conditions in both stator and rotor of a typical large, high-voltage turbo-generator. Examples, based on these curves, are given to show that a low temperature rise guarantee for the stator does not necessarly result in margin for overloads. This margin for overloads is the main argument that can be advanced in favour of low temperature rises. The only way in which the purchaser can be certain of overload margin is to have the specifications call for the maximum rating desired, in which case the maximum safe operating temperature may logically be made the temperature guarantee.

HELICAL TUNGSTEN FILAMENTS

A rather curious point in connection with tightly coiled tungsten filaments is discussed in a paper by Mr. B. E. Shackelford, published in the (American) *Physical Review*. It has frequently been noticed by those working with helical tungsten filaments that the inside of the helix is very much brighter than the outside, and pyrometer measurements on the outside and on the brightest portions of the inside of the same turns of such filaments show the brightness of the latter to be, in some cases, more than twice that of the former.

The object of the investigation in question was to determine the causes of the observed differences. Two possible explanations have been suggested: the interior may be at a temperature sufficiently higher than the exterior, or the increased brightness may be due to the radiation added by reflections within the helix.

After an extensive series of pyrometer and other experiments, the author reached the following general conclusions:—That the interior of the helical tungsten filament has a maximum brightness of the order of twice that of the exterior. That the inside is redder, and that the increased brightness is, in the main, due to internal reflections. That the temperature difference between the inside and the outside of an unusually heavy filament operated at 2,000° K. is not greater than 5°, as the maximum difference allowable from resistance and pyrometer measurements. That for all ordinary lamps the calculated difference is of the order of 1°. Values of the emissivity of tungsten have been obtained for two wavelengths at two temperatures. That tungsten radiates selectively in the visible portion of the spectrum in such a way as to make the amount of radiation, relative to that of a black body, greater in the blue than in the red.

The Institution's Christmas Greeting.—A Christmas greeting card is to be sent by the Institution of Electrical Engineers to all of its members on active service. The card, which bears on the top left-hand corner an embossed portrait of Faraday, contains the following message:—"The President and Council and the Members of the Institution of Electrical Engineers send hearty greetings to all Members of the Institution on active service, and wish them God-speed and a happy return. Christmas, 1916."

Northampton Institute.—The Annual Prize Distribution at Northampton Institute, Clerkenwell, E.C., took place on Saturday last.

LOCAL NOTES

Bognor: *Increased Prices.*—The Board of Trade has replied to the Council's complaint that the Bognor Gas and Electric Supply Co. is imposing a minimum charge for electricity supply. It is pointed out that the Company can under its Act of Parliament charge a minimum of 1¾d. The Company has explained its action by referring to the abnormal increase in the cost of supplying materials, and to the fact that the electricity portion of their undertaking is working at a loss.

Glasgow: *Wiremen's Wages Dispute.*—The arbitrator in the dispute between the Electrical Contractors' Association of Scotland and the Electrical Trades Union in connection with an application by the latter for an advance of 2d. per hour for their members has awarded to electricians and armature winders an increase of ¾d. per hour on the same terms as those on which this increase was granted to the men concerned in the Clyde district by the award of the Committee of Production on September 20 last.

Islington: *Increased Charges.*—A further increase of 10 per cent. is recommended in the charges for electricity supply, making 25 per cent. since the war began.

Lancashire: *Tramway Dispute.*—Owing to the demands from the Tramway Workers' Union received by a large number of the Lancashire tramway authorities for wages increases, these authorities formed themselves together to deal with the matter, and to arrive at a uniform basis for all towns. At Rochdale the tramway men who applied for an increase in August recently gave 21 days' notice to leave work if the increase was not granted. This expired on Sunday last, but the Ministry of Munitions warned the men of the consequences of their act, and ordered arbitration for to-day (Thursday). The men have gone back pending the result of the arbitration.

Malvern: *Extensions Refused.*—The Ministry of Munitions has refused to sanction a proposed expenditure of £2,400 on new mains.

Montrose: *Public Lighting.*—An arrangement has been made with the local Electric Lighting Company by which the Council shall pay £625 per annum of the full public lighting and £290 under the present restricted conditions.

Paisley: *Increased Charges.*—The charge for current for lighting purposes has been increased by ½d. per unit.

Sheffield: *An Industrial Development Committee.*—A committee has been appointed to deal with questions arising in connection with the industrial development of the town. The electricity undertaking is playing an important part in this matter.

Sheffield: *Electricity Extensions.*—The Corporation has decided to promote a Bill seeking powers to erect a new power station at Blackburn Meadows at an estimated cost of £1,500,000.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-Stations, Mains, &c.

Manchester.—The Electricity Committee require water tube boilers and induced draught plants at Stuart Street. Chairman of Committee, Town Hall, Dec. 28th.

APPOINTMENTS AND PERSONAL NOTES

The Newport Corporation requires competent wiremen. Wages 42s. per week of 54 hours plus 3s. war bonus.

The salary of Mr. E. P. Austin, assistant electrical engineer to the Chesterfield Corporation, has been increased from £220 to £250 per annum.

CALENDARS, &c., FOR 1917

The Electric Construction Co. have kindly sent us one of their little pocket calendars in a neat leather case of conveniently small size.

MISCELLANEOUS BUSINESS NOTES AND TRADE ANNOUNCEMENTS

Price of Copper.—Messrs. George Smith & Son, 5, Philpot Lane, E.C., inform us that the price of electrolytic wire bars, c.i.f. port of arrival, quoted on Tuesday night, was £156 to £161. (Last week, £164 to £168).

Change of Address.—Dr. F. Mollwo Perkin, consulting and analytical chemist, is removing from 199, Piccadilly, to "Albion House," 59, New Oxford Street (Tel. Museum 2854). Analytical and technical work will be carried out as before at his laboratories at Sudbury, Harrow (Tel. Wembly 108).

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Northampton Electric Light & Power Co.—The capital is to be increased by 50,000 £1 B shares.

India Rubber, Gutta Percha & Telegraph Works Co.—There was a net profit of £133,779 for the year to Sept. 30. A dividend of 15s. per share is recommended, making 10 per cent. for the year free of tax, after transferring £50,000 to reserve. The carry forward is £40,216.

Ferranti.—There was a net profit of £3,500 last year against a loss of £1,000 on the previous twelve months. No dividend is paid on the ordinary shares, the Preference interest still being considerably in arrears.

Dick, Kerr & Co.—A circular just issued to the shareholders of the United Electric Car Co. on behalf of Dick, Kerr & Co., states that they are prepared to acquire the preference and ordinary shares of the United Electric Car Co. on the following terms:—(1) As regards preference shares, they will issue or procure to be transferred to preference shareholders of the United Electric Car Co. one 6 per cent. cumulative preference share of £1, fully paid, in Dick, Kerr & Co. in exchange for each preference share of the United Electric Car Co., the preference shares in Dick, Kerr & Co. given in exchange to rank for the full six months' dividend payable on April 1st, 1917, or in the alternative they will pay 20s. cash. (2) As regards ordinary shares, the price will be 15s. in cash for each ordinary share. The circular adds that the present directors of the company (other than Mr. Prestwich, who is vice-chairman of Dick, Kerr & Co.) have agreed to transfer the shares held by them on the above terms. The intention is to call a meeting of the shareholders, when the present directors of the company will retire from the board, and the shareholders will be invited to appoint a new board in their place, consisting of persons to be proposed by Dick, Kerr & Co. They have agreed to pay to the directors retiring the sum of £3,000 as compensation for loss of office.

The Royal Technical College, Glasgow.—The Governors, at the request of certain donors, offer prizes, amounting to £70, for essays on the best methods of training and employing in industries, other than agriculture, returned soldiers and sailors, maimed or otherwise. The prizes will be awarded by a Committee of the Governors, and may be withheld in the event of no essay of sufficient merit being submitted. The decision of the Committee on this and all other points will be final. Essays must be sent in not later than March 1st, 1917, addressed to The Director, the Royal Technical College, Glasgow.

The County of London Co.'s Staff War Bulletin.—The latest issue of the County of London Electric Supply Co.'s Staff War Bulletin shows that a further fifty-four men have joined the Services since the last issue in June, making a total of 408. The list of wounded has, unfortunately, increased, and now numbers forty-nine, whilst it is also recorded with regret that the list of killed has increased to twenty-four. A number of the staff who joined as privates have secured commissions, whilst the military medal has been awarded to Private H. F. Gill, who has since been promoted to Second-Lieut., R.E. (Wireless Section).

A Valuable Business Aid.—We have received from the British Thomson-Houston Co., Ltd., Mazda House, 77 Upper Thames Street, London, E.C., a copy of their quotation No. 53,210, dated December 11th. This quotation tabulates and prices a great variety of wiring accessories, the prices for small and large lots being clearly shown. Electrical contractors and others who are on the firm's mailing list to receive quotations when issued will find them highly important as showing the prices ruling at the time of receipt. The issue of these quotations is, as far as we know, unique, but we understand that the B.T.-H. Co. have issued quite a number of them recently.

ELECTRICAL ENGINEERING

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With which is Incorporated

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SUMMARY

We are able to give some further illustrated particulars of the Sperry searchlights (p. 482).

A number of books are reviewed on p. 483.

A question dealing with the effect of sea-water on a secondary battery is answered in our Questions and Answers columns (p. 484).

A review of the work of the Diesel Engine Association during 1916 is given (p. 484).

Among the subjects of specifications published last Thursday at the Patents Office were electric welding and meters. Patents relating to electro-heaters and wireless telegraphy have been granted in spite of opposition. Patents for recording instruments and tramway section insulators expire this week after a full life of 14 years (p. 485).

A new 6,000-kw. turbo-alternator has been installed at Birmingham, and a large generating set is also on order at Sunderland.—Sir Alexander Kennedy has recommended a 3,000-kw. set at Kilmarnock, but the borough electrical engineer thinks a 5,000-kw. set is necessary (p. 486).

The enemy shares in the Sterling Telephone & Electric Co. have been acquired by Sir John Bethell, M.P. (p. 486).

1st LONDON ENGINEER VOLUNTEERS

Headquarters, Chester House, Eccleston Place.
Orders for the Week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Officer for the week.—Platoon Commander J. O. Cheadle.

Next for duty.—Platoon Commander A. Gerard.

Monday, Jan. 1st.—Technical for Platoon No. 9 at Regency Street. Squad and platoon drill, Platoon No. 10. Signalling Class. Recruits' drill, 6.25. Lecture on telephones, 7.30.

Tuesday, Jan. 2nd.—School of Arms, 6—7. Lecture, 7.15. "Street Fighting," by Coy. Cdr. Hynam.

Wednesday, Jan. 3rd.—Instructional class, 6.15. Platoon drill, No. 1 Platoon.

Thursday, Jan. 4th.—Platoon drill, No. 7 Platoon. Ambulance class, 6.30.

Friday, Jan. 5th.—Technical for Platoon No. 10 at Regency Street. Squad and platoon drill for Platoon No. 9. Signalling class. Recruits' drill, 6.25. Lecture on telephones, 7..30

Saturday, Jan. 6th.—Commanding Officers parade, 2.45, uniform, for drill in Battersea Park.

Sunday, Jan. 7th.—Entrenching at Otford. Parade Victoria (S.E. & C. Rly. booking office) 8.45 a.m. Uniform, haversacks, and water-bottles. Midday ration to be carried. Railway vouchers provided.

Musketry.—For all Companies, see notice at Headquarters.

Note.—Unless otherwise indicated, all drills, &c., will take place at Headquarters.

THE WAR AND "ELECTRICAL ENGINEERING"

Our Last Issue

After exactly ten years of weekly publication, "Electrical Engineering" is forced to take leave of its readers. Like so many other enterprises in these difficult times, we have struggled hard against adverse circumstances. One by one however we have seen the members of our staff taken from us for military duties, and the proprietors at last find themselves obliged to close down while their newspaper is at the height of its popularity. During the first weeks of the war, the unmarried members of the staff who were of military age, joined the forces. The Editor and Managing Director (Mr. F. C. Raphael) has received a commission in the Army and is stationed away from London; the Assistant-Editor (Mr. S. R. Roget), who is also a Director of the Company, is now in the Anti-Aircraft Corps (R.N.V.R.) and has up to the present—not without considerable difficulty—devoted the time between his hours of duty to carrying on the paper with the limited staff still at his disposal. Now, however, the number has dwindled so much that further publication has become impossible. We reluctantly bow to the force of circumstances. In doing so, we find some comfort in the thought that our compact and concise budget of weekly news, which we believe was just that which our readers required to enable them to keep in touch with the trend of events in the electrical world, will be really missed in the future. In bidding them farewell, we take the opportunity of thanking our many friends for the kind support and help that has been so freely accorded to us during the past ten years.

The Kilowatt Publishing Co., Ltd. (proprietors of "Electrical Engineering") will immediately go into voluntary liquidation. All liabilities will be paid in full, and claims should be addressed at the earliest possible moment to The Liquidators, 203 Temple Chambers, Temple Avenue, E.C.

THE INDEX TO "ELECTRICAL ENGINEERING."—Volume XII., January to December, 1916, is now in preparation, and will shortly be issued. The price will be one penny per copy, post free, two pence. Orders should be sent *during the next few weeks*, to the Publishers, 203-206 Temple Chambers, London, E.C.

BINDING "ELECTRICAL ENGINEERING." Volume XII., January to December, 1916. Readers who desire to have their volumes bound in the Publishers' standard cover should send their numbers *at once* to the Publishers, 203-206 Temple Chambers, London, E.C., sending under separate cover a remittance for 4s. 6d., the completed volumes will be returned, cariage paid, to any address in the United Kingdom.

The British Westinghouse "Club News."—The *Club News* issued by the British Westinghouse Co., for Westinghouse men with His Majesty's Forces, takes the form of a "Blighty" number for December. The illustrations and reading matter in this must appeal to the feelings of the large number of the Company's staff who are at present serving their country, and particularly so the numerous little touches relating to the staff which only members of the firm, naturally, can fully appreciate. A striking picture in the centre of the paper is that of a brawny workman wielding a sledge hammer, to which is given the inscription: "Strike Hard in the Coming Year."

THE SPERRY SEARCHLIGHT

WE have already (ELECTRICAL ENGINEERING, Oct. 19, page 394) given some general particulars of the principles and construction of the Sperry Searchlight, but we have now had the pleasure of seeing one of these remarkable lamps at work at the London works of the Sperry Gyroscope Co. (13a, Ebury Bridge Road, S.W.), and are able to give our readers illustrations of the actual lamp in its latest form, and a few additional details as to its working.

It will be remembered that the principal feature of the lamp is the attainment of a higher intrinsic brilliancy in the positive crater by the arc than is possible with ordinary carbon by the use of chemically impregnated or flame carbons, and a very high current density. With the special carbons used and the precautions taken, the problem of obtaining a constant supply of bright gas and the formation of a deep crater have been satisfactorily solved, and a steady and quiet arc is obtained having an intrinsic brilliancy of as much as 500 c.p. per sq. mm., against the maximum of 150 c.p. per sq. mm. obtainable with pure carbon electrodes, with the result that a very powerful, white and steady beam is obtained, giving an illumination at the target more than eleven times as great as that produced by an ordinary carbon searchlight of the same size.

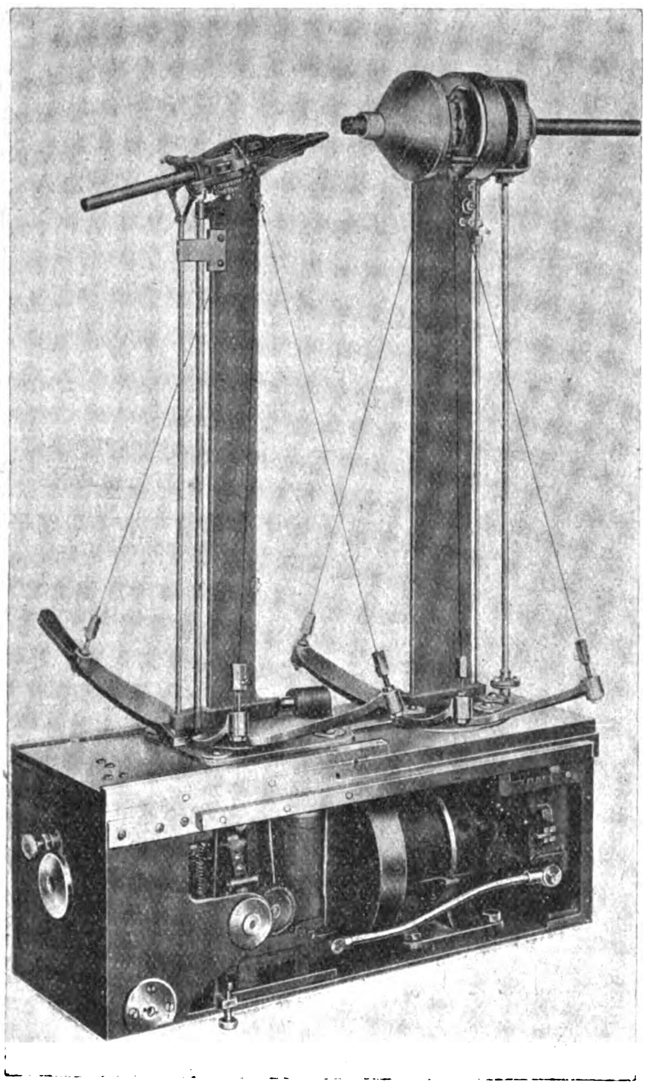

FIG. 1 —SPERRY SEARCHLIGHT LAMP.

To do this it is necessary to cool the positive carbon to prevent it from becoming so tapered that a satisfactory crater could not be formed. In the Sperry lamp, the cooling of the positive carbon is accomplished very simply and effectually by a strong current of air from a small blower in the base of the lamp which forces the air through the hollow electrode supports and around heat radiating discs which form part of the carbon holders. This current of air not only cools the carbon, but forms a protecting shield between the positive holder and the arc, which permits the lamp to be tilted at any angle without endangering the positive head. In addition to cooling the positive carbon, it is also necessary to rotate it in its holder in order to maintain a uniform deep crater in which the bright vapour can be held. If the carbon is not rotated the upper edge of the crater burns away, and allows the bright vapour to escape as fast as it is formed. A further complication of the carbon holders is due to the necessity of feeding the carbons through the holders instead of feeding the holders themselves, as in the old type of searchlight. This is due to the length and small diameter of the carbons, which make it impossible to support the carbons or to supply current to them from the ends. In the Sperry lamp, the rotating of the positive carbon and the feeding of the carbons through their holders is done through suitable gearing by the blower motor in the control box. It was also found that the negative flame, which is used to keep the bright vapour pressed into the positive crater, must be carefully directed to effectually trap the vapour and not destroy the edges of the crater. The proper angle of impingement for each size of lamp has been carefully determined by experiment, and the negative head designed accordingly. Owing to the large quantities of waste gases given off by the high intensity arc, forced ventilation of the searchlight drum is also necessary. This has been found extremely difficult in nearly all cases, owing to the sensitiveness of this type of arc. With the Sperry system of air cooling, however, the lamp itself becomes a natural ventilator, since the exhaust air entrains the waste gases and fumes, and carries them directly to the exhaust fan. In this way the waste gases are at once eliminated, and at the same time the arc is so protected by the exhaust air that the complete ventilation of the drum can be effectually carried out without disturbing the arc in the slightest. The deep positive crater required to hold the bright vapour is obtained by proportioning the cored positive carbons so that the core burns away faster than the carbon shell. The formation of this crater is further aided by the fact that the contact resistance drop at the positive is greater for the hard shell than for the core. The greater part of the current, therefore, flows to the core, though this path is longer than that to the shell tip. Owing to the small size of the carbons, a rapid burning of the positive carbon is necessary to secure a sufficient supply of the bright vapour required. The positive carbons are therefore made very long to avoid frequent renewals. For the 90 cm. searchlight, they are 16 mm. in diameter and 100 cm. long. The normal current for this size is 150 amperes, and the average rate of consumption about 20 cm. per hour. The negative carbons are 11 mm. in diameter and 30 cm. long. They are made of solid carbon and are copper coated to protect them from oxidation, and to reduce the heating due to the electrode resistance.

The general appearance and arrangement of the lamp and the complete searchlight are shown in Figs. 1 and 2.

In the system employed for cooling the positive carbons the air supplied to the positive holder is forced around a number of heat radiating discs surrounding the end of the holder nearest the arc, and escapes from a slot in the top. It therefore serves both to carry off the heat which is conducted along the carbon from the arc, and also to shield the mechanism of the positive holder from direct radiation from the arc and its flame. The exhaust air escaping from the positive carbon holder tends to hold the arc flame in position, and also entrains the waste gases from the arc and carries them off. This allows the lamp to be tilted at any angle without danger to the positive head, since the air blast always holds the arc flame perpendicular to the positive carbon. The cooling air for the negative passes up the hollow electrode support and out around the carbon and the feeding mechanism. Less air is required to cool the negative since it is protected from oxidation by its copper coating and because the tip of the negative carbon is much cooler than that of the positive.

In order to keep the positive crater symmetrical, and to prevent the escape of the bright vapour, the positive carbon must be rotated continuously. This is done by the blower motor in the control box, which rotates the positive holder in its support by means of a gear train and a vertical shaft. The negative is not rotated. The current passes into the positive carbon through silver brushes, which are pressed against the rotating carbon by springs. The positive holder is firmly fixed to the control box, and the positive carbon is fed through it. This feeding is done by the blower motor in the control box by means of a gear train and a suitable mechanism in the positive head which forces the carbon through the head.

The positive crater is kept at the focal point of the mirror by controlling the rate of feed of the positive carbon either manually by means of handle in the control box, or automatically by means of a thermostat and solenoid. The thermostat consists of two strips of metal fixed at one end, and attached to multiplying levers at the other. These levers carry contacts at their ends, which are opened when the ray from a focussing mirror strikes one of the metal strips. The focussing mirror and thermostat are mounted so that the reflected ray from the arc does not strike the rod when the crater is in its proper position. The normal rate of feed is more rapid than is actually required, but as soon as the crater is fed nearer to the mirror than the focal point the reflected ray strikes one of the rods, the contact is opened, and the feed interrupted until the carbon burns back to the correct position. The negative carbon is also fed through its holder, but it is not rotated. The feed is controlled by means of a solenoid connected directly across the arc, which moves a series of levers, as the voltage rises and falls, so as

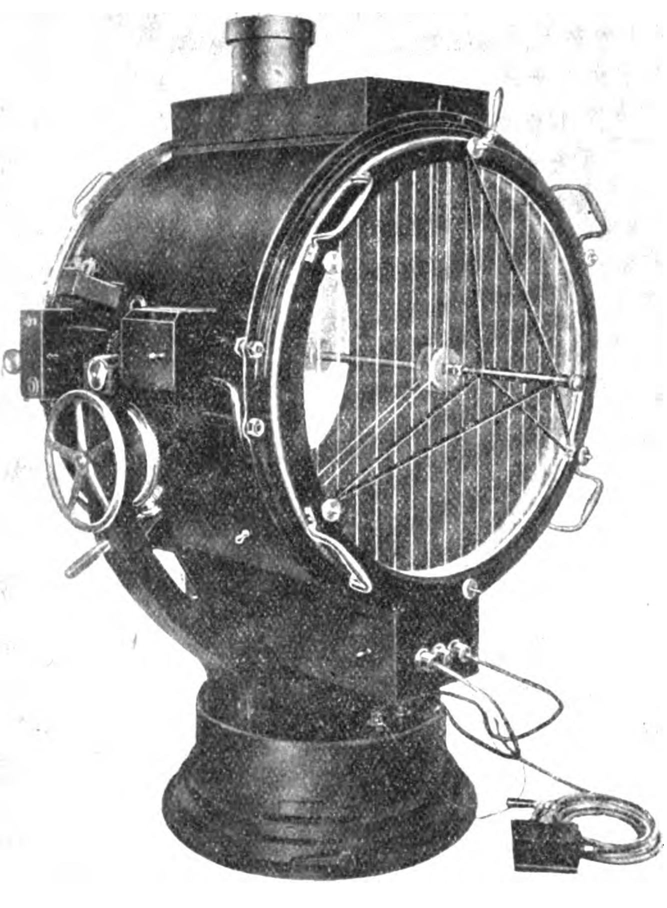

FIG. 2.—SPERRY SEARCHLIGHT COMPLETE.

to cause the blower motor to feed the negative carbon backwards or forwards as required.

The ventilation of the barrel is another very important feature. Not only is all deposit from the arc fumes thereby prevented, but the mirror is at the same time kept from becoming dangerously hot. Air is drawn in through an intake behind the mirror, and passes through a space between the mirror itself and the outer packing, and on through suitable ducts into the barrel, from which it is extracted by an exhaust fan at the top.

We have seen a complete lamp in a 36-in. projector in operation, taking 150 amperes at 75 volts across the arc, and were much struck with the even nature of the crater, the steadiness of the light, and the remarkably perfect working of the feed mechanism. It will be seen that the lamp differs little from the original form which we described before, but there are many little practical details which space forbids our discussing, and must be seen to be appreciated.

REVIEWS OF BOOKS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

A Text-Book of Practical Physics. By H. S. Alley and H. Moore. 622 pp. 8 in. by 5½ in. 297 figures. (London: Macmillan and Co., Ltd.) 8*s.* 6*d.* net; abroad, 9*s.* 4*d.*

WE like the title, implying as it does a text-book for the student who is studying physics primarily for its practical applications, and the book is essentially one for a student, for every stage of its exposition of the subject is illustrated by an experiment, and after each of the main sections of the book are a number of "Additional Exercises." The teaching is good and clear. Our chief criticism is that there has not been sufficient endeavour to interest the student by occasional digressions to indicate the practical utility of the matter which he has to assimilate with a certain amount of mental effort. A book published in 1916 and containing a chapter on dynamics might reasonably be expected to say something about projectiles, but the word is not even mentioned. The chapters on sound could be made more interesting by explaining the principles upon which a gramophone, a telephone, or even a megaphone, an organ pipe, or a Klaxon is based. The parabolic mirror apparently is not included in the examination syllabuses which are guiding the authors, and the elementary principles of steam and thermal combustion engines are omitted from the section on heat. In the last section, "Electricity," however—although it starts with rubbing things with flannel or silk to produce vitreous or resinous electrification—the student is able as he proceeds to derive a better idea of the possible ultimate application of what he is being taught, although here also the tendency to confine the teaching to that which can be illustrated by particular laboratory apparatus which presumably happens to be available to the authors is rather too marked.

Wireless Transmission of Photographs. By M. J. Martin. 117 pp. 8¾ in. by 5¾ in. 62 figures. (London: Wireless Press, Ltd.) 2*s.* 6*d.* net; by post, 2*s.* 9*d.*

IT is an early date in the progress of telegraphic transmission of pictures to publish a book on "Wireless Transmission of Photographs," especially when it is remembered that the effective reproduction of even simple sketches telegraphically over short land lines is still in the early experimental stage. Yet the author is certainly performing a useful service in describing the attempts that have been made in this direction, including his own. Issued with the cachet of the "Wireless Press," the book must be taken seriously, and we must conclude that it is sufficiently historical and up to date. It would have added to the interest of the publication, however, if reproductions of actual results had been shown.

Metal Filament Lamp Litigation.—An action by the British Thomson-Houston Co., Ltd., against Duram, Ltd., for alleged infringement of patents relating to metal filament lamp manufacture was heard before Mr. Justice Astbury before Christmas and judgment was given just before the recess. The first patent of which infringement is alleged is dated 1906 and the second 1911, the former relating to the treatment of metallic tungsten and the manufacture of filaments, and the latter to an improved method of drawing wire by the use of graphite as a lubricant. The case occupied a considerable time, and the usual leading patent lawyers were engaged on either side. Mr. A. J. Walter, K.C., Mr. Colefax, K.C., and Mr. Gray were briefed by the British Thomson-Houston Co., and Mr. T. Terrell, K.C., and Mr. Kerly, K.C., and Mr. C. Terrell were retained by Duram, Ltd. In his judgment Mr. Justice Astbury said that the questions at issue were the validity of the patent of 1906, the want of novelty, subject matter, and insufficiency being alleged against it. So far as this patent was concerned, his Lordship held that it was bad for want of subject matter, and was therefore invalid. The second patent of 1911 he also held was invalid on the ground of prior user. The action thus ended in favour of Duram, Ltd.

QUESTIONS AND ANSWERS
BY PRACTICAL MEN

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient general interest to our readers will either be replied to under "Answers to Correspondents," or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

ANSWER TO No. 1,617.

I am in charge of a battery of 33 secondary cells (Premier make). Owing to structural alterations above, sea-water has recently been dripping through the ceiling and into about half the cells. Can any of your readers tell me if this will seriously affect them? At present they all keep up their normal voltage and take the charge and discharge as usual. There is no difference in the appearance of plates or acid, except one cell has a kind of frothing on the top. On taking a sample of this frothing and applying a match, it ignited with an explosion. A choking gas is given off from the cells; would this be chlorine? The drops of water from the ceiling taste slightly of acid; is this possible? What is the chemical action producing these effects? The specific gravity seems to have risen in the cells affected. Why?—"A. E. B."

The first award (10s.) is given to "F. P. S." for the following reply :—

If the battery has been charged daily, or even frequently, the permanent injury to the cells will probably be of no consequence. The principal permanent alteration will be that the liquor will contain sulphate of soda Na_2SO_4. But some years ago washing soda was not infrequently added to retard sulphating of the plates, and as the soda was immediately converted into sulphate of soda no very bad effects need be feared. One effect of adding soda was a slightly reduced E.M.F. The chief salt in sea-water is common salt, that is sodic chloride NaCl approximately 30 parts per thousand in sea-water; next in order is magnesic chloride $MgCl_2$ 4 parts, then magnesic sulphate $MgSO_4$, 1·76 parts, then magnesic bromide 0·88 part. In the ordinary charging of the cells these chlorides and the bromide will be split up by electrolysis, the chlorine and bromine will be given off as gas, and cause the choking odour noticed. Eventually all the chlorine and bromine will be thus eliminated, but the sodium and magnesium will remain in the liquor in solution as sulphates. There is no practicable way of getting rid of them. I may say that although battery acid is supposed to be free from chlorides I have never yet started a battery without noticing a strong odour of chlorine during the first charge, and eventually the liquor seems to get perfectly free from it.

If it were possible for the chlorides to remain as chlorides, that is, without being eliminated during charging, they would attack the plates forming chloride of lead, the sulphuric acid would attack this chloride, forming insoluble sulphate of lead and liberating hydrochloric acid, which would again attack the plates, this would go on continuously, and the battery would be ruined.

The drops of water from the ceiling taste slightly acid probably because they condense the acid spray given off when the battery is being fully charged. The froth explodes on applying a match because it has locked up some of the oxygen and hydrogen gas given off towards the end of the charge. If the bubbles floating on the normal cells towards the end of the charge be touched with a lighted match they will likewise explode; the compound thus formed is water, H_2O. The density of sea-water is lower than the density of battery acid, the rise in density will be due to the sulphate of soda in solution.

No reply worthy of a second award has been received.

DIESEL ENGINE USERS ASSOCIATION

At the December meeting of the Diesel Engine Users Association the proceedings were mostly of a formal nature, dealing with the election of a President, of new members of the Committee to replace those retiring, etc. Mr. Geoffrey Porter, A.M.I.C.E., Borough Electrical Engineer to the Corporation of Worthing, was re-elected President for a second year. Messrs. R. W. Lyle (Messrs. Hoffman Manufacturing Co., Chelmsford) and W. Fennell (St. Albans) were elected members of the General Committee. Mr. Percy Still (Chelsea) was re-elected as Honorary Secretary.

The Honorary Secretary made a general statement of the position of the Association and of the work carried out during the year 1916. The total membership of the Association to date is 79, being an increase of 31 Diesel engine users during the year. The total horse-power represented by the Association has doubled during the year, being now 46,108 B.H.P. as against 23,984 B.H.P. at the end of the previous year.

In view of the interest taken in the proceedings and the work of the Association by many engineers and others interested in the successful use of Diesel engine plant, but who were ineligible for election to membership under the rules, the Committee after careful consideration had put forward a suggestion that a class of "Subscribers" be admitted. A person or a firm not qualified for full membership may be accepted by the Committee as a "Subscriber" on payment of a subscription of one guinea per annum. "Subscribers" are entitled to receive regularly copies of the reports of the proceedings at meetings, but they are not entitled to attend any meeting of the Association (except by special invitation of the Committee), or to have any voice in the control of the Association. "Subscribers" may at any time send communications to the Honorary Secretary, and, if in the opinion of the Committee these are of sufficient general interest, such communications may be read and discussed at a meeting of the Association.

A considerable amount of attention has been given during the year to the subject of the use of tar oils as fuel in Diesel engines. In view of the high price of imported fuel oil, and of possible shortage in the future consequent on the conditions brought about by the war, much stress has been laid on the importance of encouraging in every possible way the use of a home product as fuel. As a result, several members of the Association have already commenced to use tar oils in their Diesel engines, either with a pilot ignition apparatus fitted to the engine, or without, and a considerable amount of useful experience has been obtained in the use of this class of fuel. Further trials are still being made with various methods of using tar oil, and several members are awaiting further information on the subject before placing orders for tar oil. Certain difficulties in connection with the use of tar oil have to be met, but there appears to be no doubt that if such fuel can be supplied to a suitable specification in various parts of the country at a reasonable price, Diesel engine users would soon make the necessary arrangements for its use, either wholly or partially in place of the imported product.

The explosion which occurred in an air compressor attached to a Diesel engine at an electric generating works in February was a subject of discussion at several meetings. The matter was then referred to the Committee for further consideration, and they were requested to draw up a report and to make any recommendations that might appear to be advisable for the guidance of the members on the general question of air compressor explosions and troubles. This report has now been issued in pamphlet form, copies of which can be obtained from the Honorary Secretary.

At the June meeting, the President (Mr. Geoffrey Porter) read a paper on "Oil Engines and Steam Engines in Combination," in which incidentally he also strongly urged the adoption of tar oils as fuel, not only as a precaution in view of possible developments, but from the national point of view. The paper was accompanied by instructive tables of statistics of typical small steam electric generating works and combined steam and oil plant generating works. A useful paper by Mr. P. H. Smith on "Precautionary Measures to adopt to Prolong the Life of Diesel Engine Crankshafts," contained in-

"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published December 21st, 1916

A full list of electrical patents published last week appeared in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

6,036/16 (*100,401*). **Electric Welding.** E. Woltman. A system of arc welding, in which the work forms one electrode and the carbon pencil held in holder forms the other. The hand tool is rendered comparatively easy for an inexperienced operator to use by the provision of automatic regulation of the arc length. If the carbon is held too far from the work, a solenoid is caused to alter the position of the lever holding the carbon relatively to the handle, and thus keep the arc a constant length. Similarly, the carbon is withdrawn if the tool is brought too near.

8,310/16 (*102,335*). **Meters and Relays.** British Westinghouse Elect. & Mnf. Co. An electric meter or relay, in which the increasing torque is compensated for, comprising a motor having an armature, the torque of which varies as the square of the current in the motor winding, and is connected to the main circuit through a transformer having two windings, one of which is connected in parallel with the motor winding and the other in series with the parallel circuit comprising the motor winding and the first transformer winding.

Specifications Published To-Day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, W.C., at the price of 6d. each, including inland postage.

Dynamos, Motors, and Transformers: Chitty [Dynamos] 12,748/15; Schroeder [Rotary converters] 17,155/15.

Ignition: J. L. Evans [Sparking plugs] 1,897/15 (*102,402*).

Switchgear, Fuses and Fittings: International Electric Co. and le Noir [Switches] 16,993/15; British Thomson-Houston Co. (*Electric Controller & Mnf. Co.*) [Electromagnetic switches] 17,195/15; A. K. Modi [Casings] 203/16 (*102,387*); A. E. Read, J. E. Franks, and M. Brooks [Wall boxes] 2,044/16 (*102,404*); R. B. Benjamin [Lampholders] 8,339/16 (*100,836*).

Telephony and Telegraphy: International Electric Co. and le Noir [Hotel and other signalling] 16,992 and 17,000/15; Orling and Orling's Telegraph Instruments Syndicate, Ltd. [Current reversing apparatus for telegraph circuits] 17,260/15; Relay Automatic Telephone Co. and Herink [Automatic and semi-automatic telephone systems] 17,386/15; Siemens Bros. & Co. and T. Pettigrew [Telephone circuits] 3,599/15 (*102,419*); F. Ritchie [Signalling apparatus] 7,616/15 (*102,444*); R. B. Benjamin [Lampholders] 8,333/6 (*100,836*); E. Merriman [Telephone systems] 9,179 (*102,454*).

Miscellaneous: Lancashire Dynamo & Motor Co. & Hargreaves [Magnetic clutches] 14,026/15; A. A. King [Electric torches] 4,625/16 (*102,426*); British Westinghouse Elect. & Mnf. Co. [Method of producing asymmetrical waves] 9,927/16 (*100,893*).

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Ignition: R. Henry & E. Herrmann [Sparking plugs] 16,423/16 (*102,490*).

Telegraphy and Telephony: Western Electric Co. [High-frequency signalling] 17,003/16 (*102,500*) and 17,170/16 (*102,503*).

Traction: Soc. Anon. pour l'Equipment Electrique de Vehicules [Control of car-lighting, etc.] 12,420/16 (*102,483*).

Miscellaneous: British Westinghouse Elec. & Mnf. Co. [Vacuum type inverted converters] 14,767/16 (*102,484*).

Amendment made

13,801/15. **Series system of power transmission.** R. Thury. This specification has been amended by way of disclaimer. It describes a method of regulating series machines by providing an exciter, the field of which is differentially excited by the line current and by a current drawn from a source of substantially constant voltage, and further by a compounding coil, the effect of which depends upon the voltage across the terminals of the machine.

Opposition to Grant of Patents

Grants of patents have been allowed on the following applications in spite of opposition:—

23,676/14. **Electric Heating.** F. S. Grogan. Heating elements of wire helices of small diameter, mounted in a fire-clay frame to form a hot plate, and with the convolutions more widely spaced at the centre than near the edges to equalise the heat.

11,555/15. **Wireless Telegraphy.** F. K. Vreeland. A system of generating continuous oscillations employing a mercury vapour arc concentrated in a restricted stream of high energy transforming capacity.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

28,749/02. **Recording Instruments.** T. J. Murday. Recording instruments with a special form of counterweighted pen pivotted in a fork at the end of the instrument pointer, and moving with very light pressure over the travelling paper strip.

28,768/02. **Tramway Overhead Lines.** J. M. & A. Anderson. Section insulators for trolley wires.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors and Transformers: H. A. Mavor & Mavor & Coulson, Ltd. [Electric propulsion of floating docks, etc.] 20,213/09.

Ignition: R. Bosch [Ignition system with electromagnetic plugs] 13,527/08 and 15,262/08.

Switchgear, Fuses and Fittings: British Thomson-Houston Co. (*G. E. Co., U.S.A.*) [Electrolytic lightning arresters] 18,619/08.

Traction: W. R. Sykes [Electric locking gear for mechanically worked signals] 19,092/03; K. von Kando [Electric locomotives] 19,697/03.

Miscellaneous: W. H. Chapman [Discharging electricity from paper] 19,419/04.

formation of much interest in connection with the subject of crankshaft fractures, etc.

The subject of the allowance made by the Inland Revenue Authorities for depreciation of Diesel engine plant in connection with income-tax assessment has been kept in view by the Committee. Up to the present, however, the Inland Revenue Authorities have not taken any steps to arrive at a settlement of the matter, and the position remains that the Association strongly recommends its members to insist on an allowance at the rate of 15 per cent. per annum on the diminishing capital value of the plant, this being the method of allowance adopted by the Income-Tax Authorities, and that in paying any tax the extra 10 per cent. claimed (above the present allowance at the rate of only 5 per cent.) be deducted and retained.

The important subject of lubrication was again brought before the Association in a paper read by Mr. George B. Vickers on "Piston and Small End Lubrication in Diesel Engines." The ensuing discussion brought out further points of interest, and as there appears to be a general desire for further information and discussion on the whole question of lubrication, it has been arranged that Mr. Elliott A. Evans will at the meeting next January read a paper on "Chemistry and Examination of Lubricating Oils."

AN ELECTROMAGNETIC DRAWING BOARD FOR ONE-ARMED DRAUGHTSMEN

IN order to enable draughtsmen who have lost one arm in the war to continue their work, a special appliance has been developed in Germany by the A.E.G., in the form of a magnetic drawing board, on which scales, set-squares, curves, etc., may be held firmly in position, leaving the hand free to manipulate the pen or pencil. The appartus is illustrated and described in the *Elektrotechnische Zeitschrift*, and consists of a drawing-board on a stand, which can be tilted to any angle, with a large number of magnet poles, each with an exciting coil arranged close together in regular rows under the surface. The magnets are excited by closing a foot-switch and retain the steel squares, etc., in any position to which they have been adjusted. The current is only on when pressure of the foot on the switch is maintained, and the energy consumption is given as 0.3 kw.

NEW PUBLICATIONS

We shall be pleased to post any of the undermentioned works to any address in the United Kingdom, Colonies, or Abroad at the prices given. Orders should be addressed to the Kilowatt Publishing Co., Ltd., 203-6 Temple Chambers, Temple Avenue, London, E.C., accompanied by a remittance.

Handbook of Machine Shop Electricity. By C. E. Clewell. 460 pages. 4 in. by 7 in. 57 figures. New York: McGraw-Hill Book Co.; London: Hill Publishing Co.) 12s. 6d.

Electrical Engineering: Advanced Course. By E. J. Berg. 330 pages. 6 in. by 9½ in. 163 figures. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co.) 15s.

Applied Electricity for Practical Men. By A. J. Rowland. 375 pages. 5½ in. by 7¼ in. 323 figures. (New York: McGraw-Hill Publishing Co.; London: Hill Publishing Co.) 8s. 4d.

Spon's Electrical Pocket Book. By W. H. Molesworth. 488 pages. 4¼ in. by 6½ in. 325 illustrations. (London: E. and F. N. Spon, Ltd.) 6s.

General Cargo: An Introduction to Salesmanship. By R. E. Goddard. 199 pages. 5 in. by 7¾ in. (London: Constable & Co., Ltd.) 4s. 6d.

Some Modern Methods of Ventilation, with Special Reference to Public Buildings. By R. Grierson. 187 pages. 5½ in. by 8¼ in. With illustrations, charts, and tables. (London: Constable & Co.) 8s. 6d.

LOCAL NOTES

Birmingham: *New Plant.*—A new 6,000 kw. turbo-alternator has been installed by the Electricity Department, and is in full operation. It is now hoped to be able to meet the demands of the Tramway Department, and so avoid the unpleasant interruptions in the supply which have been taking place of late rather more frequently than the public, at any rate, have cared for.

Dorking: *Price of Electricity.*—Messrs. Edmundson's Electricity Corporation, which own the electricity works at Dorking, have asked the Council to agree to an increase of 10 per cent. in the charges now made for electric supply. Already 10 per cent. has been added to the pre-war prices, and the Finance Committee now recommend the Council to approve of a further increase of 5 per cent., making 15 per cent. in all. The addition is to apply to lighting only, power users already paying 20 per cent. increase on the pre-war price.

Edinburgh: *The Tramway Question.*—In connection with the recent report upon the proposed electrification of the Edinburgh cable tramways, a new development has taken place which, says the *Scotsman*, seems to indicate on the part of the company a spirit more amenable to compromise. One of the points to be settled at the expiry of the lease is the terms on which the cars are to be taken over by the Corporation. The Tramways Company, in the course of the earlier negotiations, asked £75,000 under this head. The Corporation valued the cars at £25,000. It is understood that the company have now offered to compromise on the basis of a valuation of £50,000 for the cars, or £250 each. They are also willing, it is understood, to undertake the upkeep of the rails for a period of six years after the expiry of the lease. This offer, it is believed, will be carefully scrutinised by the Tramway Committee of the Town Council. A considerable number of the members are averse to entering into any arrangement which would to any extent tie the Corporation's hands in the way of committing them to a continuance of the cable system beyond the expiry of the lease.

Hull: *Position of the Tramways.*—A rather disquieting statement was made last week as to the financial position of the Corporation tramways by the Chairman of the Committee, but it is pointed out that there is no cause for alarm. The undertaking is as financially sound and flourishing as any in the country. It has a reserve fund of over £140,000, which is within £5,000 of the maximum allowed by the Act of Parliament, and last year there was a profit of £12,469. This year so far there is an increase of £2,000 in the receipts, but owing to the increase in expenditure, it is anticipated that there will be a loss of £2,500 at the end of the financial year to March. The difficulties have to a large extent been brought about by the withdrawal of men for military service, which has resulted in a reduced service of cars, and consequent smaller earning capacity. There is every prospect that by adjusting the service more nearly to the demands of the travelling public, an improvement in the financial position will be brought about.

Ipswich: *New Plant.*—The Electric Supply and Tramways Committee was recently called upon for an immediate and considerably increased demand for electric power by Messrs. Ransomes, Sims, and Jefferies, Ltd., at Orwell Works, and with the assistance of the Ministry of Munitions plant already in course of construction for other purposes was obtained and will be delivered about the middle of January. The Corporation is purchasing the plant for Messrs. Ransomes, Sims, and Jefferies, who will pay for the whole cost of the installation. Arrangements have also been made for the Corporation to take it over at the end of seven years at a price similar to that which the plant could have been purchased and installed for before the war.

Kilmarnock: *New Plant.*—The Electrical Engineer reports that in his opinion Sir Alexander Kennedy's recommendation to instal a further 3,000 kw. turbo-alternator will not meet the future requirements of the undertaking. He advises a 5,000 kw. set in order to give a reasonable margin of reserve. Mr. Bexon also points out that there is at present insufficient boiler capacity to deal with the new load, and recommends the disposal of two of the three Lancashire boilers now in use, and the substitution for them of a Babcock and Wilcox boiler with an evaporative capacity of 25,000/30,000 lbs. of steam per hour. The comments of the Borough Electrical Engineer are to be referred to Sir Alexander Kennedy for his opinion.

London: *St. Pancras. New connections to be Refused.*—Owing to the restriction recently placed upon the use of copper by the Ministry of Munitions, the Council has decided that for the present no applications for electric current, other than those for war purposes, can be accepted.

Sunderland: *New Plant.*—The Ministry of Munitions and the Treasury have agreed to the Corporation spending £45,000 upon new plant at the Hylton Road Works. A tender for a new turbo-alternator, which forms part of the scheme, has been accepted.

COMPANIES' DIVIDENDS, REPORTS, MEETINGS, &c.

Dick, Kerr & Co.—It is stated that the acquisition of the shares of the United Electric Car Co. by Dick, Kerr & Co. does not mean that the former will cease to exist as a separate concern. All the members of the present Board, however, with the exception of Mr. R. H. Prestwich, who is Vice-Chairman of Dick, Kerr & Co., will retire in favour of nominees of the purchasing firm, and will receive £3,000 as compensation for loss of office.

Sterling Telephone & Electric Co.—We understand that the whole of the enemy shares of the Sterling Telephone & Electric Co., Ltd., have been acquired from the Public Trustee by Sir John Bethell, Bart., M.P., who will act as Chairman of the Committee.

CALENDARS, &c., FOR 1917

We have to thank the British Thomson-Houston Co. for a copy of their large wall calendar for 1917. This is arranged with a month on each sheet, which also gives the preceding and following months, in addition to illustrations of the products of the firm.

From the Anglo-Mexican Petroleum Products, Ltd. (Finsbury Court, Finsbury Pavement, E.C.), we have received a large calendar for 1917.

Our special thanks are due to the Simplex Conduits, Ltd. (Garrison Lane, Birmingham), for an artistic and extremely useful desk-blotter, and also for their usual pocket diary.

The Hart Accumulator Co. (Marshgate Lane, Stratford, London) is distributing to its friends a blotting-pad which contains the calendar for 1917 on each sheet.

1D.

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WITH WHICH IS INCORPORATED

THE ELECTRICAL ENGINEER

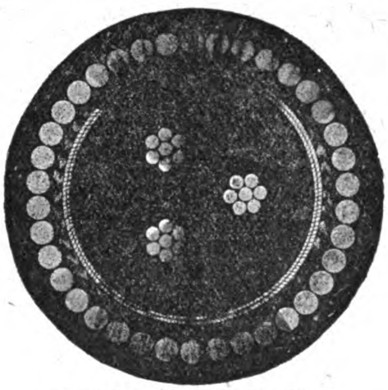
(Established 1884)

1D.

No. 471 [Vol. XII., No. 1]
Registered as a Newspaper.

THURSDAY, JAN. 6, 1916.

[Price One Penny.



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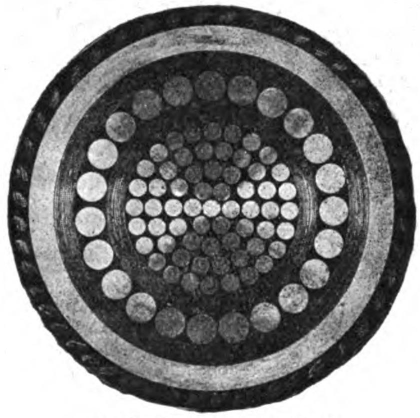

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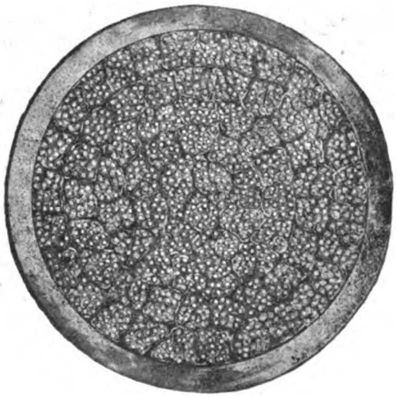

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Speedy, Eynon & Co., 6, Duke Street, Adelphi, W.C. (8967 Central).

Trollope & Colls, Ltd., 77, Grosvenor Road, S.W. (1971 Victoria), also 5, Coleman Street, E.C., and at Dorking, Surrey.

F. Troy & Co., 194–196, Finchley Road, N.W. (opposite L. & N. W. Railway Station). (3161 & 3162 Hampstead)

BRIGHTON.—Page & Miles, Ltd., 60, Western Road.

BURNLEY.—Simpson Brothers, Curzon Street.

CARDIFF.—Ralph Nance, A.M.I.E.E., 2, Dock Chambers.

CROYDON.—Thos. Hyde & Co., 180, London Road. (542 P.O.).

GLASGOW & DISTRICT.

Wm. McWhirter & Son, 212, 214, & 216, Holm Street.

HULL.

Alexander Shaw, 66 & 68, Brook Street.

WOLVERHAMPTON.—Wolverhampton Electric Fittings & Installation Co., 28, Darlington Street.

The charge for insertion in the above list is 5s. per quarter (prepaid).
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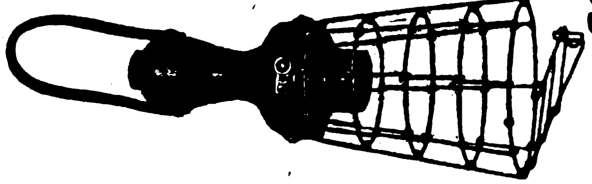

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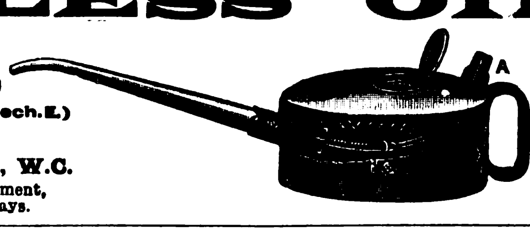

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R. A. CHATTOCK,
City Electrical Engineer & Manager.

Electric Supply Offices,
14 Dale End, Birmingham.
January 4th, 1916.

FOREMAN wanted by a firm of Engineers, under Government Control, in London District to take charge of a View Room, dealing with small electrical parts. Applicants should have had good electrical manufacturing experience and a sound theoretical training. One used to the supervision of both male and female labour preferred. Those already on Government work need not apply. Write or apply to nearest BOARD OF TRADE LABOUR EXCHANGE, mentioning THIS PAPER and NUMBER 4110.

BINDING "ELECTRICAL ENGINEERING."—Vol. XI. of "Electrical Engineering" (Jan.—Dec. 1915) closed with our issue of Dec. 30th. Readers can have their volumes bound by their own bookbinder; or, they may send their numbers to THE KILOWATT PUBLISHING Co., LTD., Temple Chambers, London, E.C., carriage paid (with the reader's name and address), and a remittance of 4s. 6d. under separate cover. The volumes will then be bound and returned carriage paid to any address in the United Kingdom, or carriage forward to the Colonies or abroad. Binding Cases (including index, but not including binding) 2s. each, or post free 2s. 5d. (Abroad 2s. 6d.) Index alone, 1d. (Post free 2d.).

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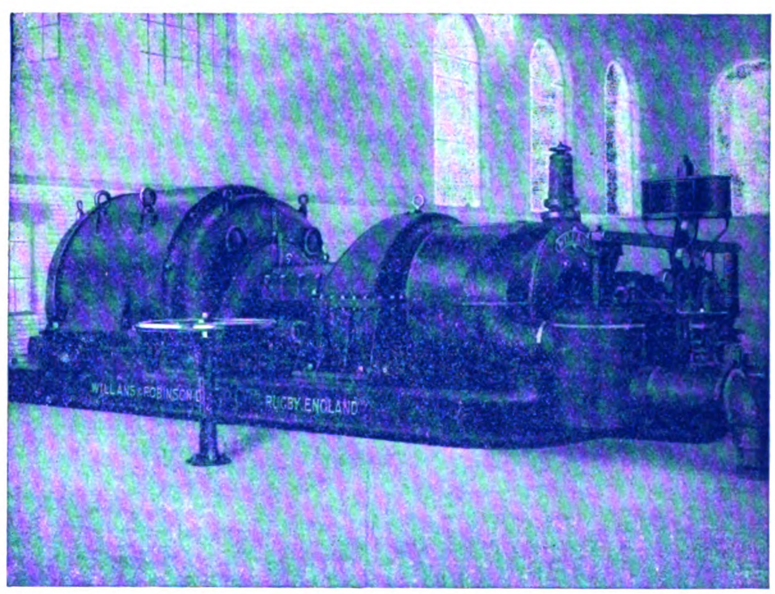

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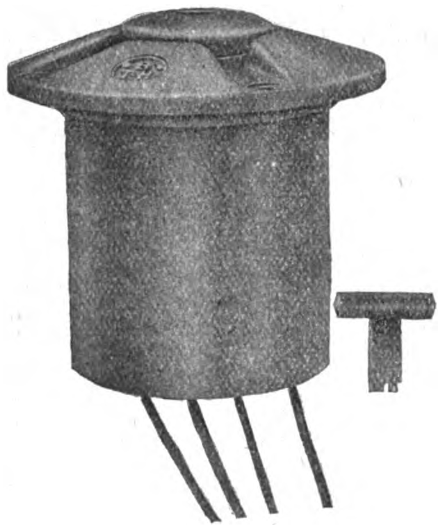

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